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18

PRACTICAL OBSERVATIONS

IN

S U R G E R Y.



BY

HENRY EARLE, F.R.S.

ASSISTANT SURGEON TO ST. BARTHOLOMEW'S HOSPITAL,
AND SURGEON TO THE FOUNDLING.

LONDON :

PRINTED FOR THOMAS AND GEORGE UNDERWOOD,
32, FLEET STREET.

1823.

1777

LONDON:

PRINTED BY J. MOYES, GREVILLE STREET.

TO THE
PRESIDENT, TREASURER, AND GOVERNORS
OF
ST. BARTHOLOMEW'S HOSPITAL.

GENTLEMEN,

IMPRESSED with the highest respect and veneration for the truly royal foundation over which you preside, and the affairs of which you direct and support, I feel anxious to dedicate to you the following volume of practical Surgery.

Should it be found to contain any thing conducive to the improvement of my profession, or calculated to alleviate the sufferings of my fellow-creatures, I rest satisfied that it will receive your approbation.

Gladly do I embrace this opportunity of expressing my gratitude to an Institution to

which I owe so much, and with which I may boast an hereditary connexion of nearly a century; to an Institution, of which our country may be justly proud, as constituting one of her noblest temples of Christian charity, and one of her most valuable schools of medical Science.

It is to the ample stores of experience, afforded me by St. Bartholomew's Hospital, from the earliest period of my professional career, that I am indebted for whatever share of public confidence I now enjoy, and for whatever success may have attended my humble efforts to relieve "the numerous ills that flesh is heir to."

With every sentiment of respect and gratitude,

I have the honour to be,

GENTLEMEN,

Your most obedient and faithful Servant,

HENRY EARLE.

George Street, Hanover Square,

June 20th, 1823.

P R E F A C E.

AFTER the numerous works which have appeared on fractures of the lower extremities, I feel that some explanation of the motives which induce me to publish, and some reasons for again soliciting the attention of my professional brethren to this subject, may be required.

The difference of opinion which prevails among many of the most enlightened members of our profession as to the most eligible mode of treating these cases, and the great variety of instruments which have at different times had their advocates, may be stated generally as convincing proofs that perfection in this department has not yet been attained. Having enjoyed very extensive opportunities of submitting the various plans of others, as well as several contrivances of my own, to the test of experience, I conceive that I am enabled to point out some of the sources of our errors, to solve some of the difficulties attendant on the

subject, and to reconcile some of the discrepancies which exist in our opinions concerning it.

I may also be allowed to observe, that the frequency of such accidents, the difficulty of treating them, the lameness which is so constantly the result of unsuccessful treatment, and which is not merely destructive of the beauty of the erect form, but of the health, happiness, and bodily exertion of the individual, may be urged as a sufficient justification for bringing forward any additional evidence, which may have a tendency to elucidate the subject or improve the practice.

Besides these general motives, however, there is one of a more special nature, which, I must confess, influences me more particularly at the present moment:—I have the misfortune to differ in opinion from a highly eminent practitioner *with regard to the possibility of union of the neck of the thigh-bone, when broken within the capsular ligament*; and as that gentleman has recently given his sentiments on this subject to the profession, I am particularly desirous to submit mine also to their consideration, that they may judge between us.

Sir Astley Cooper, in his recent work on

Fractures and Dislocations, has stated it as his opinion, that perfect union under such circumstances cannot take place, and that more or less deformity and lameness must be the inevitable consequence of these accidents.

Such is the doctrine which he has for many years inculcated into the minds of his numerous pupils; and this doctrine is now gone forth into the world with the stamp of his name, and the sanction of his extensive experience*.

It is with great deference, therefore, that I come forward to combat his opinion; but as I conceive it to be erroneous, and think it can be proved to be so, I am sure that the candour of

* In the 13th Number of the Medico-Chirurgical Review, Dr. Johnson observes, " It has been *falsely* stated that Sir A. Cooper has said that union of the fracture of the neck of the thigh bone was impossible." It is true that Sir Astley has introduced a saving clause, in which he says, that to deny the possibility of such an occurrence would be presumptuous; but it is equally true that the whole tenour of his work conveys the impression that union will not take place, and that it is quite in vain to expect, or attempt to promote it; and the practice which he pursues, and which he recommends to others, is founded upon this principle.

that gentleman will justify me in his eyes; and my duty to the public and to the profession will be a sufficient answer to the charge of presumption in any other quarter: for it must be obvious to every one, that opinions so confidently asserted, emanating from such high authority, must necessarily chill the spirit of inquiry, and consequently impede the progress of improvement.

In proof of the justice of these remarks I may mention, that in a paper lately read before the Medico-Chirurgical Society, describing a very ingenious apparatus for fractures of the lower extremities, the author, an old pupil of Sir A. Cooper's, employs the following language in speaking of fractures within the articulation:—

“ On fractures through the cervix femoris it is unnecessary to make any remark, as, from the nature of the accident, let the limb be placed in either position, we shall meet with the same unfortunate termination.”

I have repeatedly heard similar sentiments expressed by other pupils of the same school. I might add, that the unqualified language of most of the reviews and journals has so far extended the influence of the opinions which

have been broached by Sir A. Cooper, as to render it doubly necessary that some one should come forward to investigate the real merits of the case.

I am fully aware of the disadvantages under which I labour in entering the arena with a veteran, who so deservedly enjoys the public confidence and esteem. When, however, I consider the serious consequences which must result from the diffusion of an erroneous opinion of a man so eminent in his profession, which, if suffered to be promulgated without qualification, will afford but too convenient a shelter for negligence and ignorance, I do not think myself at liberty to hesitate about taking up the gauntlet; and if the arguments which I may bring forward should induce the profession to withhold their decision for a while; and, instead of at once abandoning all such cases as hopeless, to endeavour to perfect the treatment of them, and thus to reduce the sum of human misery, I shall feel myself amply recompensed.

ON an attentive and dispassionate revise of the following work, since the sheets have been

printed off, some expressions appear to have escaped me in the warmth and hurry of composition, which may possibly admit of a construction very different from my wishes or intentions. I am anxious, therefore, most distinctly to disclaim the slightest feeling of disrespect towards the author whose work I have reviewed; and should any passages appear to the reader as too strongly expressed, I must entreat his indulgence in referring them to the ardour of a person writing on a subject which has occupied much of his attention, who was anxious to establish opinions which he has long entertained, and to introduce a practice which he hopes will be found beneficial. In doing so, it was necessary to examine critically the foundations on which the opposite opinions were built. In contending, however, against the doctrines of Sir Astley Cooper, nothing was ever more remote from my intention than to attempt to detract from the acknowledged and well merited reputation of that gentleman; and it would cause me real pain to suppose that any personal feeling could be excited by the perusal of the following pages.

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PRACTICAL OBSERVATIONS
ON
FRACTURES
AT THE
UPPER PART OF THE THIGH,
AND
FRACTURES WITHIN THE HIP-JOINT.

PRACTICAL OBSERVATIONS,

ETC. ETC. ETC.

Μεγάλη γὰρ ἡ αἰσχυρὴ καὶ βλάβη ἑξαχύτερον τὸν Μηδὸν αποδειξαι.

ἹΠΠΟΚΡΑΤΗΣ. Περὶ Ἀγμων.

INTRODUCTORY OBSERVATIONS.

PREVIOUSLY to entering upon the subject of fractures of the upper part of the thigh, it will not, I trust, be deemed superfluous to refresh the memories of my readers, by briefly considering some circumstances connected with the anatomical structure and form of the thigh-bone, and the articulation of the hip; and the changes which those parts undergo at different periods of life.

Clear ideas on these points are essentially necessary to enable us to form a true estimate of the value of any plan of treatment, and to vary and adapt our means to the peculiar exigences of each individual case as they may arise.

*On the Anatomy of the Thigh-bone in
the Adult.*

THE thigh-bone is the longest in the body.

To facilitate its description, it is convenient to divide it into three portions, and to consider its relations under three several heads; namely, its superior, or pelvic extremity; its body, or shaft; and its inferior, or tibial extremity.

The upper portion presents three eminences; the head, the trochanter major, and trochanter minor. The head of the bone is of a rounded hemispherical form; its direction is inwards, and it rises above the level of the greater trochanter. It is covered in the recent state with cartilage, except at its centre, where there is a depression for the interarticular or round ligament by which it is connected with the cotyloid cavity of the pelvis. This eminence, or head, is sustained in the adult on a neck of considerable length, which connects it with the two trochanters and the shaft of the bone. This neck is of a cylindrical form,

and is narrowest about one third from the head: as it approaches the trochanters its base becomes more extended, it is enveloped by prolongations of the fibrous or capsular ligament, which serve the purpose of a periosteum, and also by a reflected layer of the synovial membrane. It forms an obtuse angle with the shaft of the bone: the degree of which varies considerably in different individuals, and in the different sexes.

The great trochanter is placed at the upper and outer part of the thigh. It is of a flattened quadrangular form, and of considerable density; rather convex on its outer surface, where the tendon of the glutæus maximus plays upon it, and irregularly concave on its inner surface, where the gemelli, pyramidalis, and obturatores muscles, are inserted into it. It is bounded in front by an edge, into which the glutæus minimus is attached; behind, by another edge, for the insertion of the quadratus; to its superior surface the glutæus medius is attached; below it is bounded by the vastus externus. The trochanter minor is below the level of the trochanter major, and more internal:

its form is pyramidal, and it is variable in its length: it serves for the attachment of the united tendons of the *psoas magnus* and *iliacus internus*. A prominent oblique line unites the two trochanters at their posterior part; and a similar, but less marked, line passes in front, and is directed downwards and inwards. These two lines bound the neck, and afford attachment to the fibrous or capsular ligament.

The shaft of the bone is of a rounded form at its two upper thirds, enlarging and becoming broader and flatter towards its inferior extremity. The direction of the shaft of the bone is obliquely inwards as it descends, so that the two bones converge and nearly touch at their inferior extremities, or inner condyles. The degree of obliquity varies in different persons, and is the greatest in females, from the greater breadth of the pelvis above. It is considerably curved forward, to admit of a greater space being left behind for the lodgment of powerful muscles. This arched form likewise affords a greater resistance to the tendency which the body has to fall forwards. This oblique direction and arched form should be particularly borne

in mind by the surgeon, when he is preparing any apparatus for fractures of the thigh, as I shall have occasion more particularly to mention hereafter.

The inferior portion offers an extended surface for articulation with the tibia. When the shaft of the bone is placed in a perpendicular direction, the inner condyle is considerably lower than the outer; but, in the natural oblique position of the bone, they are both on the same level, and are adapted to the nearly plane surface of the tibia.

At its superior extremity, the thigh-bone is connected with the pelvis, and contributes to form the hip-joint. Its rounded head is, in a great measure, received into the acetabulum, or cotyloid cavity of the os innominatum, and is capable of being moved to a considerable extent without quitting it. Both articular surfaces are thickly incrustated with cartilage; except at the point of insertion of the ligamentum teres, and at an excavation at the bottom of the acetabulum, which is filled with cellular tissue and fat. The cartilage becomes thinner as it approaches the margins of the head of the bone. The depth and security of the cotyloid cavity cannot be duly estimated by

viewing the skeleton. Its brim, in the recent state, is considerably prolonged, and, consequently, its cavity increased by the addition of a very firm, circular, fibrous band, named the cotyloid ligament, which supports the circumference, fills up the inequalities, and renders the edge of the cavity perfectly uniform.

The capsular ligament is the strongest of all the ligaments of this class. It is fixed to all the circumference of the acetabulum, exterior to the cotyloid ligament, and also to the ligament itself, at the inferior part: it is then directed downwards and outwards, embracing the articular surfaces as far as the base of the cervix femoris, and is fixed in front, where it is longest, to the posterior oblique line; above, to the root of the inner side of the trochanter major. This ligament is tighter than that of the shoulder-joint, in consequence of the length of the neck keeping it extended. It is of considerable thickness at the upper and anterior part, where it is much strengthened by a firm fasciculus of fibres, which pass from the anterior inferior spine of the ileum to the anterior oblique line of the femur. At this part numerous foramina may be observed,

giving passage to vessels between this ligament and the synovial membrane. On the inner and lower part the ligament is much weaker.

Prolongations of the fibrous membrane are reflected over the neck of the bone, and terminate at the base of the head. These are strongest at the anterior and inferior part of the neck. They serve the purpose of a periosteum to the neck, and are of great importance with reference to the treatment of fractures within the capsular ligament.

The interarticular or round ligament consists in a bundle of ligamentous fibres, which extends from the rough excavation in the head of the femur, and is inserted into the two extremities of the cotyloid notch by two bands, which separate from each other at this part. This ligament is so disposed that luxation of the femur on the obturator foramen is the only one which can happen without rupturing it; an occurrence which is inevitable in all other dislocations.

In describing the synovial membrane, it is difficult to commence at any one part, as it lines the whole joint. For convenience we may begin in the cotyloid cavity, at the

bottom of which it is very apparent on the reddish cellular tissue, from whence it may be elevated by inflation across the notch, which transmits the vessels. It is seen upon the cotyloid ligament, and descends upon the inner surface of the capsule, to which it communicates its polish, and from which it may be separated. Having arrived at the base of the cervix femoris, it quits the capsular ligament, and is reflected to invest the fibrous periosteum of the neck: from thence the membrane proceeds to the cartilage of the head, which it covers throughout, except at the insertion of the interarticular ligament. In that situation it sends off a prolongation in the form of a canal, which embraces the ligament, and accompanies it as far as the reddish tissue above described.

The hip-joint, in addition to the powerful ligaments which have been described, and the depth of the acetabulum, owes much of its strength to the muscles which surround it. In front it is covered by the tendinous expansion of the rectus femoris, and the united tendons of the psoas and iliacus internus; a bursa being interposed between

the latter tendons and the joint: inwardly, by the pectineus and obturator externus: behind, by the quadratus, the gemelli, the pyramidalis, and obturator internus: above, by the glutæus minimus.

Of all the articulations in the human body, there is none, perhaps, more constantly in action than the hip-joint, and there is none whose motions are so difficult to be restrained. Situated immediately in the centre of motion of the trunk, the pelvis, and whole lower extremity, and constantly participating in every alteration of position in either of these parts, it is liable to more frequent interruptions to a recovery from disease or accident than any other joint.

When the trunk is fixed, and the extremity is moved, as in progression, or any other act, it is in the acetabulum that the principal motion originates; so, likewise, when the extremities are the fixed points, and the pelvis and trunk are moved upon the head of either, or both thigh-bones, it is here that every motion must necessarily centre.

It will, perhaps, be well to dwell a little on this subject, and consider the different

directions in which it is capable of being moved, and their influence in the production of accident, and in retarding recovery from disease. It will much facilitate our subsequent considerations on the nature of the different injuries which occur to the joint.

The movements of the articulation of the thigh-bone in the acetabulum are the same as those of the shoulder-joint, but they are more limited. This arises from the immobility of the pelvis, the depth of the acetabulum, and the considerable resistance and strength of the ligaments. Circumduction, which consists of a succession, or combination of the various movements of flexion, extension, adduction, and abduction, is much less extensive than in the shoulder-joint. It may, indeed, be said, that circumduction and rotation are in an inverse ratio in the upper and lower extremities. This evidently arises from the different conformation of the upper end of the femur and that of the humerus. In the former the existence of a long neck prevents the axis of the bone, which is far removed from the centre of motion, from being the lever of circumduction, as the axis of the humerus is in the

arm: consequently the lever of circumduction in the femur is represented by a line extended obliquely from the centre of the joint to just between the two trochanters. The motion of rotation, which is so remarkable in the femur, scarcely exists in the humerus. This depends upon the length of the neck in the former, the axis of which is the lever of this movement. Rotation may be performed outwards or inwards. The former is nearly the natural position of the lower limbs, which position they owe to the number and strength of the muscles, as almost all the rotators of the thigh have a direct tendency to turn it outwards. Rotation inwards is far more limited; when it does take place, the trochanter makes a great projection under the integuments, and the head of the bone buries itself more deeply in the articular cavity. The number and power of the rotators of the thigh may probably arise from the influence which they exert over the whole lower extremity; for, when the limb is straightened, the rotation of the neck of the femur causes a corresponding motion in the foot. In this respect there is a marked difference between

the upper and lower extremities: the pronation and supination of the hand being performed by the rotation of the radius on the ulna: while in the lower extremity the rotation of the entire limb, when extended, centres in the head of the femur, and is referrible to the length and direction of the neck of that bone. When the leg is half bent upon the thigh, a slight rotation of the leg and foot can indeed be accomplished, which then has its centre in the knee-joint. This intimate correspondence between the motions of the foot and upper part of the thigh is of infinite importance to be borne in mind, in ascertaining the nature of accidents to which the hip-joint is liable, and in the proper treatment of those cases. It should never be forgotten that, in the extended position of the leg, the direction of the foot will be a certain index of the neck of the femur.

The length and direction of the neck of the femur is not only essential to the rotation of the whole limb, and consequently to the diversified and graceful motions of the lower extremities; but greatly facilitates progression, and mainly contributes to the

security of the trunk in the erect posture, by extending the base of support which the thigh-bones afford to the pelvis and body. At the same time the oblique direction of the neck diminishes the effect of the pressure which the trunk communicates to the head of the femur, and the distance from the acetabulum to the great trochanter, occasioned by the length of the neck, enables man to stand for a considerable time on one leg; an attitude which quadrupeds, from the shortness of the neck of the femur, are incapable of assuming.

Thus, then, we see the very important and complicated functions which are performed by the length and direction of the neck of the thigh-bone. I have been induced to dwell thus much upon this subject, from a wish to impress upon the reader the necessity for endeavouring to preserve this part as perfectly as possible, both as to length and direction, after the receipt of the injuries about to be spoken of; as it must be obvious that the most serious inconvenience, and permanent lameness, must be the inevitable consequence of neglect.

On the State of the Thigh-bones in Childhood.

THE whole lower extremities are less developed in the foetus, and during childhood, than the upper. The nature of their functions, the exercise of which does not commence until a considerable period after birth, easily explains this difference, which is more immediately dependent on the smaller proportion of blood, which is transmitted to them at this period. The principal differences which exist in the femur, and which claim our attention, as connected with the question about to be discussed, are the following:—In the first place the neck of the bone is shorter, and more nearly approaches to a right angle with the shaft of the bone: hence arises the smaller basis of support of the trunk, and, consequently, the greater vacillation in the erect posture. Secondly, the neck of the bone is entirely cartilaginous, and, consequently, is much weaker, and incapable of sustaining the weight of the body for any length of time. Thirdly, the shaft of the bone is nearly straight, instead of being arched forward,

which has been shown above greatly to contribute to sustain the weight of the body in the adult. In proportion as the body assumes the erect posture, and as the motions of the limbs are multiplied, they lose the characters described above: the shaft of the femur becomes curved, and the neck becomes longer and larger, and forms, with the body, an angle more obtuse: the neck, however, remains long in a state of epiphysis, and frequently its consolidation is not complete until the fifteenth or even the twentieth year. During the whole of this time the head of the bone receives no other supply of blood than is furnished through the ligamentum teres, and reflected layer of the synovial and fibrous membranes; and this is sufficient to effect the complete ossification of the head, even when separated by the whole cartilaginous neck, in which no vessels can be traced, from the shaft of the bone.

Of the Changes which take place in advanced Life.

IN old age the neck of the thigh-bone, in common with the other bones in the body,

undergoes changes which render it more liable to be broken by the action of very slight causes, which, at an earlier period of life, would not be attended with such serious consequences. It has been repeatedly ascertained that the bones of old emaciated persons are of less specific gravity, than those of persons in the middle period of life, and that they become so soft as even to admit of being readily cut, and, consequently, afford but little resistance to the action of external violence. These changes are the consequence rather of deficient nutrition, than any increased absorption. The period at which they take place is very uncertain, and must depend more on the constitution than the age of the individual.

*On Fractures at the upper Part of the
Thigh-bone.*

IN the following pages I shall confine myself to the consideration of fractures of the upper part of the femur, and particularly of the neck of that bone. The frequent occurrence of such accidents, and the acknowledged difficulty of treating them, are sufficient reasons for making them the subject of a distinct treatise.

It is a commonly received opinion, that the ancients were ignorant that the hip-joint was liable to any other accident than dislocation; and the credit of the discovery of the possibility of a fracture occurring at the neck of the femur, has been generally attributed to Ambrose Parey. The fact being once established, soon led to a further investigation of the subject, when not only its possibility, but its frequent occurrence, became known. A Dutch surgeon, named Borst, states, “Sese octies aperuisse anuum claudicantium cadavera, et semper invenisse ossa in collo fuisse fracta, et ne ullum quidem exarticulatum.” There were not want-

ing, indeed, some men who carried this doctrine into the extreme, and who boldly asserted that no dislocation could take place unattended by fracture of the neck of the femur.

That a fracture of the neck is a more common accident than dislocation, is abundantly proved by the testimony of Desault and Richerand, and by the fact of our hospitals being rarely without several instances of such accidents. That it is a too frequent source of lameness and deformity, is testified by the many unfortunate cripples we daily meet, who, at the same time, may be said to be living monuments of the imperfection of the means employed for their recovery. The frequent occurrence of the accident has been explained by Hoffman, Ruysch, and other authors, as dependent on the great strength of the ligamentum teres, which is more difficult to be torn than the neck of the bone is to be broken. This explanation is unnecessary, as the force, which most commonly is the cause of fracture, does not operate in a direction calculated to displace the head of the bone from the acetabulum.

The neck of the thigh-bone may be broken at different parts of its extent, either at the junction of the head with the neck, or at the most contracted part, about mid-distance between the head and trochanters, where the parietes of the bone are thinnest. The most frequent situation is at the junction of the neck with the shaft of the bone, in which case the fracture often extends from the root of the trochanter major to the trochanter minor, and is partially, if not entirely, exterior to the capsular ligament. This latter accident is occasionally complicated with fracture of the trochanter major, in one or more places; and in this case the neck of the bone is generally forced between the trochanter and shaft of the bone. It has been remarked that fractures of the neck, at the narrow part, are generally in a transverse direction; a circumstance which may arise from the thinness of the parietes of the bone, which is principally composed of cancellous structure, covered by a very thin layer of compact bony matter.

The neck of the thigh-bone is so protected by the surrounding soft parts and the trochanter major, that it is completely

defended from the immediate action of external violence; and, consequently, from any direct fracture. It follows that it must be broken by a contre-coup, either by a fall on the trochanter, the feet, or knees. The former of these is by far the most frequent cause; although, on a superficial view, it may not appear the most probable. Desault says, that, in his practice, twenty-four cases in thirty were produced in this way. The experience of Sabatier and Richerand proves the same fact.

In the very ample opportunities I have had of witnessing these cases; in the wards of St. Bartholomew's Hospital, and elsewhere, I have met with only three exceptions to this. In two cases, of young persons, the apophysis was detached from the epiphysis, in consequence of a perpendicular fall on the foot; and in one case, the neck gave way within the capsule, from a mere muscular effort in emptying a pail of water, and twisting the body and pelvis at the same moment, while the lower extremities remained fixed.

A little consideration will explain the mode in which fractures are produced by

falls on the trochanter. In these cases the weight of the body, increased by the impetus of the fall, acts in one direction on the head of the bone, which is placed in the hard unyielding acetabulum; while the trochanter major meets with resistance from the ground upon which it falls. Thus the neck is placed between two forces, whose combined action tends to straighten the angle of the neck into a right line; the consequence of which, from its inelastic nature, must be a fracture at its weakest part. A large majority of the cases, which I have witnessed, have been caused by falls on the pavement, or slipping from the edge of the curb stone. Occasionally the force of the fall has been increased by a heavy weight, which the person has been carrying at the time, or from having been knocked down by horses or carriages. Very frequently it has been caused by merely slipping down during frosty weather; and so slight has been the fall to all appearance, that much doubt has been entertained of the possibility of so serious an injury having been caused by so apparently trivial an accident.

Diagnosis.

THE diagnosis of this accident is sometimes rather difficult; there are, however, certain indications which characterize it, and which, if attended to, will generally enable an experienced practitioner to form a correct judgment.

Where a person, previously in full possession of the locomotive powers of his limb, after the receipt of any injury, and particularly after a fall upon his trochanter, becomes suddenly deprived of that power; accompanied with a remarkable consciousness of incapacity in the injured member; and when, from the position and direction of the limb, it is obvious that there is no dislocation, a strong presumption must arise that a fracture has taken place. In such a case a surgeon is *fully warranted to act on such a suspicion*, and to treat the case as a fracture, without subjecting his patient to painful examinations, to gratify his own curiosity: the consequences of which, in addition to the pain inflicted, may be most injurious, and often render complicated, what, in the first instance, was simple.

I cannot quit this subject without deprecating, in the strongest terms, the cruelty and impropriety of what is termed “satisfying yourself that there is a fracture, and its precise situation.” Such examinations it has fallen to my lot to witness much too frequently; and, in many instances, the results have been most injurious. It may possibly be urged, that, if we omit this, we may be mistaken, and subject a person to unnecessary confinement. This will very rarely occur, as the consciousness of power is so implanted in our nature, that it would be difficult indeed to persuade a person, whose limb was entire, to submit to confinement for any length of time.

The pain, the loss of power, the nature of the accident, and other symptoms, which I shall soon proceed to describe, all indicate the presence of some material injury, for the relief of which rest is probably the most efficacious remedy; and a few days will declare whether the suspicions of fracture be well or ill founded. But even admitting the possibility of a mistake, it is surely far better that a few persons should be confined for a somewhat longer period than is absolutely requisite, than that many should have

their sufferings increased, and their recovery prevented or retarded. The above remarks are applicable to all cases of fractured thighs, but more particularly to fractures of the neck, within the articulation, where so much depends on preserving, as much as possible, the integrity of the reflected layers of the synovial and fibrous membranes, which are rarely, if ever, completely torn through at the moment of the accident, but are subsequently separated, either by the exertions made in removing the patient, or the improper position in which he is placed; or, lastly, by the examinations of the surgeon.

I have been induced to dwell upon this subject, from the total silence of all systematic writers, to whose works I have referred, on this necessary caution. Not only, indeed, are they silent, but they constantly mention a crepitus, audible on rubbing the broken ends of the bone together, as one important diagnostic of a fracture.

To return, then;—This symptom of a total and sudden privation of the power of motion, after a fall on the trochanter, should always be regarded as diagnostic of a fracture: and the greatest care should be taken, in removing the patient, to maintain the limb

in its proper position, and to avoid all motion. When the above-mentioned symptom exists, it is alone a sufficient indication of fracture: but, in some very rare instances, persons have been able to stand, and even walk some distance after the receipt of the injury. This may be explained on the supposition of a mere breach of continuity in the bone; the spicula of which still remain locked in each other. A remarkable instance of this is related by Petit, in the Memoirs of the French Academy. Desault mentions a similar instance, and I have known such an occurrence in a man who fell, when at work, at the Collège of Surgeons.

The next symptom, to which I shall advert, is the degree of shortening of the limb. If a patient, having experienced a blow or fall as described, be placed in a horizontal position, on viewing the affected limb, more or less retraction will generally be perceived. This retraction is certainly the most unequivocal symptom; but it sometimes does not take place until some days after the accident; and at other times it is in so slight a degree as to elude the observation of a person unaccustomed to see these cases. This difference in the degree of re-

traction, is in great measure referrible to the situation of the fracture. When broken within the articulation, or near the head of the bone, very little or no retraction takes place at the moment of the accident. The contrary to this may be observed with respect to fractures external to the capsule.

Exactly the reverse of this, however, is advanced by Sir Astley Cooper; and as very important consequences are made to arise out of this circumstance, I shall, perhaps, be excused if I examine somewhat critically the grounds on which that gentleman has founded his opinion.

In speaking of fracture within the capsule, Sir Astley Cooper states*, that “the limb is from one to two inches shorter than the other†, in consequence of the trochanter being drawn up by the muscles as high as the ligament will permit.” — “Three or four hours,” he says‡, “must elapse before this appearance assumes its most decisive cha-

* Sir Astley Cooper on Fractures and Dislocations, p. 117, line 2.

† In the Appendix to his last edition Sir Astley Cooper states, that the limb is two inches and a half shorter.— See Appendix, p. 571.

‡ Ib. p. 119.

racter, as the muscles require some time to acquire a fixed contraction; and this is the reason that the accident has been mistaken for dislocation. The surgeon, having been called directly after the accident, before the muscles had acquired that fixed state of contraction they afterwards assume, is led to mistake the nature of the injury; and for this reason, patients, even in hospital practice, have been exposed to useless and painful extensions."

With respect to the shortening of the limb to the extent of two inches, as I have never witnessed such an occurrence, I cannot but conceive that there must be some inaccuracy in the statement, more especially when the great strength and unyielding nature of the capsular ligament are considered, the utmost extent of which at its upper part does not exceed more than two inches from its origin to its insertion: in addition to which, in the majority of cases, there is considerable resistance afforded by the undivided portion of the fibrous membrane or periosteum. Sir Astley states, that this retraction does not take place at the moment of the accident; but that it is the consequence of muscular action. As, how-

ever, in this accident, the muscles are not irritated by any spicula of bone, in consequence of the fracture being within the articulation, so are they not disposed to forcible spasmodic contraction; which will generally be found to be in proportion to the degree of injury inflicted.

Next, as to the fixed contraction, which is stated to take place in three or four hours; and “which enables the muscles to resist any extension which is not of the most powerful kind*,”—in all the instances which I have witnessed, where any retraction had taken place, there was no difficulty in drawing down the limb to its proper length, with a very moderate degree of continued extension; and indeed I can hardly conceive it possible, that in so short a space of time muscles should acquire “such fixed contraction,” as to afford any considerable resistance, more especially as we have so long and powerful a lever as the whole lower extremity, which we may employ in overcoming their opposition. I am well aware, that, after many weeks of contraction, muscles will acquire a new sphere

* Sir Astley Cooper on Fractures, &c. p. 118, line 1.

of action, which will require considerable pains and perseverance to overcome, but I should not expect that this would be the case, after a few hours only had elapsed; such a contraction could only be spasmodic, and a very slight counter-action will overcome any degree of spasm, if sufficiently persevered in.

In what manner this greater or less degree of fixed resistance of the muscles can ever have influenced surgeons, so as to mislead them in ascertaining the nature of the accident, I must confess myself unable to comprehend, since such a case must always be deficient in all the characteristic marks of dislocation; and certainly, the less degree of resistance to motion there may be, the less will be the possibility of confounding the case with dislocation. That such mistakes may have happened in hospital practice I do not mean to deny; but it is hardly necessary to remark, that in hospitals the first management and direction of accidents is submitted to the dressers and pupils, before the surgeon is called. Any hospital-surgeon who could be guilty of such an error I should deem wholly incompetent to the office.

Sir Astley has not advanced any cases or dissections in proof of the greater degree of shortening when broken within the capsule, nor of the minor degree when external to it. In support of the opposite opinion, of the very slight degree of shortening which occurs in fractures within the articulation, I shall cite the following cases and dissections:— Daniel Spilling, forty years of age, was brought into St. Bartholomew's hospital in November, 1820. He stated, that, as he was walking in the street, his foot slipped, and he fell on his right hip. He got up, but was wholly incapable of moving, or bearing any weight on the affected limb. His clothes were taken off, and whilst he was in the erect posture, no difference whatever could be detected, either in the length or position of the limb, which admitted of being moved with considerable freedom in every direction, and with less pain than is usual in fractures. On placing him in bed no deformity was manifest; and in consequence of the doubts which were entertained of the existence of fracture, the limb was examined with great freedom, and for a considerable time. He was directed to lie on his right

side, with the thigh bent on the pelvis. This position gave him great pain in the hip, and soon became intolerable, from the uneasiness it caused in the region of the liver. His health was greatly deranged at the time of his admission, and he became completely jaundiced. Very little attention was paid to the limb, his health became daily worse, and he died on the eleventh day after his admission. On viewing the body after death, a shortening of the limb to the extent of half an inch was recognised by all present, and the foot was considerably everted. On puncturing the capsule, about an ounce of bloody synovia escaped; and the introduction of the finger readily detected a fracture of the neck of the bone. A larger incision was now made; and on the limb being turned in different directions, the head of the bone was observed to move freely in the acetabulum. At first it was suggested that the fracture was incomplete, but subsequent examination proved the contrary. The fractured surfaces accurately fitted to each other, and were retained in their proper relative situation, by a portion of the reflected layer of the fibrous and synovial

membranes, of about an inch in extent, which had fortunately escaped being torn through, notwithstanding all the examinations which were instituted after the accident, and the total neglect of any apparatus to restrain the motions of the limb. On the broken surface of the superior portion or head of the bone, there were considerable granulations.

I have adduced this case, because the death of the patient afforded an opportunity for an examination, which could not fail to satisfy the most sceptical ; but I have known several instances precisely analogous, in which so little, if any, retraction existed at the time of the accident, that the greatest doubts have been entertained of the true nature of the case, and the unfortunate patients have been subjected to repeated examinations, until the long-looked-for shortening has taken place, more, I am convinced, in consequence of the improper force employed in the examinations, than from the nature of the injury sustained.

I have been further induced to select this case, as illustrating another important circumstance ; namely, the preservation of a

considerable portion of the reflected fibrous and synovial membranes. It is, I think, but reasonable to suppose, that, had the limb been from the first maintained in a state of permanent rest, the laceration of these membranes would have been to a less extent, and the recovery would have been certain, and without deformity. I have met with two other cases, in which considerable portions of these membranes remained undivided, notwithstanding the great force which was employed in ascertaining the nature of the accident, and the limbs were sensibly shortened, in consequence of the obliquity of the neck being destroyed. In both these cases death ensued a few days after the accident: in one, in consequence of severe injury to the brain; and in the other, from internal hæmorrhage, from a rupture of the liver.

As I consider the preservation of this membrane, or any part of it, as a circumstance of the greatest importance in the treatment of these cases, I feel happy in having the support of other authors, in proof of the possibility of such an occurrence, more particularly as they likewise bear testimony to

the slight degree of retraction which occurs in fractures within the articulation.

Delpech, in treating of this subject*, says, shortening is prevented “ par la capsule elle-même, qui retient par sa partie supérieure la portion du col qui tient au grand trochanter, surtout si la fracture est très près de la tête du fémur, et l’expansion fibreuse qui enveloppe immédiatement le col, et qui semble provenir de la capsule articulaire. *Cette expansion est rarement rompue, du moins en grand partie, et sa conservation est d’une grande importance.*”

The same circumstance is stated in Boyer’s Leçons, par Richerand, in speaking on the possibility of union: “ Le plus souvent, le repli ligamenteux, qui environne le col, *imparfaitement déchiré*, transmet encore quelques vaisseaux au fragment supérieur. Ces vaisseaux sont même la ressource la plus sûre et le moyen le plus puissant de consolidation.” — BOYER, *Malad. des Os*, p. 214.

In a note, he adds, “ Les mouvemens,

* Delpech, Précis Elémentaire, tom. i. p. 275, ch. 3.

que l'on imprime au membre pour produire la crépitation, toujours obscure, peuvent achever cette rupture lorsqu'elle est incomplète. Aussi doit-on apporter le plus grand ménagement dans leur exécution." It is extraordinary that the author who has given this salutary admonition should, in another place, speak of the crepitation on rotation of the limb as an important diagnostic.

Boyer likewise supports the opinion of the very slight degree of retraction in this accident; at page 209 he relates the following case:—"Un homme avancé en âge fait une chute sur le grand trochanter, l'extrémité se raccourcit d'un demi-pouce environ, aucun autre signe ne se manifeste. Le citoyen Boyer prononce que le fracture du col existe. Le malade meurt au cinquantième jour, d'hydropisie ascite, avec infiltration des extrémités inférieures. On dissèque la partie, et l'on reconnoît la fracture du col du fémur dans l'articulation. *La nature avoit même déjà travaillé, quoique infiniment peu, à la réunion des fragmens.*"

The same author gives some interesting dissections in support of the greater degree of retraction which takes place in fracture

external to the articulation. “ Un membre de la ci-devant Académie de Chirurgie fit une chute sur le grand trochanter, l'extrémité devint de *beaucoup plus courte* que celle du côté opposé, le pied et le genou se tournèrent en dehors. Traité par les moyens ordinaires, la fracture guérit avec raccourcissement du membre. Mort quelque temps après d'une autre maladie, la dissection de l'articulation présenta le col du fémur fracturé au-delà de l'insertion du ligament orbiculaire. Cette observation m'a été communiquée par le citoyen Lesne, membre distingué de l'Académie. Plusieurs cas de cette espèce se sont offerts au citoyen Boyer ; Cheselden en a fait graver quelques exemples.”

“ Il est mort à l'Hôpital de la Charité un vieillard avec une fracture du col du fémur *remarquable par le raccourcissement considérable qu'avoit éprouvé le membre*. La dissection de l'article m'a fait voir une double fracture au-delà de l'insertion du ligament orbiculaire entre les deux trochanters, dont le plus grand était détaché du reste de l'os. La réunion commençait à s'opérer, quoique le sujet fût âgé de quatre-vingt-trois années.”

Richerand, the editor of Boyer's *Leçons sur les Maladies des Os*, repeats the same observations in his *Nosographie Chirurgicale*. Louis, Duverney, and Sabatier, entertained the same opinions.

With a view to ascertain how far the statements I have made, and the opinions I have been led to entertain from my own observations, and the writings of the authors I have quoted, were borne out by the various preparations of fracture within the articulation existing in London; since writing the above, I have examined the several collections of Mr. Abernethy, Mr. Charles Bell, Mr. Heaviside, and Mr. Langstaff, and embrace the present opportunity of expressing my thanks for the great liberality I have experienced, in being allowed to examine their museums on all occasions when prosecuting any pathological inquiries. In every instance that I have examined, the retraction did not exceed from half an inch to one inch, except where the neck was entirely absorbed; and even in these cases the prodigious increased thickness of the capsular ligament prevented the limb from being retracted more than about an inch and a

half. In a large majority of cases, I was also well pleased to find a considerable portion of the reflected fibrous membrane untorn. This fact was particularly well illustrated in three specimens in Mr. Langstaff's museum. Mr. Colles, in his paper in the Dublin Hospital Reports, gives a plate of a case in which the upper part of the reflected membrane was undivided, and two-thirds of the broken surfaces were firmly united by a ligamento-cartilaginous substance of great thickness*. In all the instances which have fallen under my observation, the lower and anterior part of the membrane has been the part which remained entire.

In Mr. Langstaff's museum, there is a preparation, which is particularly interesting, from the subject of it, an elderly gentleman, having been known to Mr. L., from whom I obtained the following particulars. Several years prior to his decease, he had been thrown from a gig, and injured his hip; no fracture was then discovered, probably from the absence of any retraction, nor indeed

* Vide Dublin Hosp. Reports, vol. ii. p. 344, case 6th.

was it detected until after his death, though he continued to halt during the remainder of his life, and his limb was slightly shortened. Of course, as he was not treated for a fracture, and no means were employed to restrain the motion of the joint, bony union did not take place, but the efforts of nature to effect a restoration are very manifest, and highly interesting. The fracture is near the head, and the lower edge of the pelvic portion projects rather more than the upper; this is supported by a portion of bone, which proceeds from the trochanter minor, and forms a complete crutch, in which the upper portion is received. The cancellous structure of the pelvic extremity of the fracture is covered over with a layer of firm bone, evincing active ossifying power in that portion. This layer of bone is invested with a firm smooth vascular membrane, similar to that which covers the inferior portion; and thus a complete new joint is established. A considerable portion of the fibrous reflected membrane remains undivided. The capsular ligament is greatly thickened, and many ligamentous bands proceed from its inner surface to the edge of the fracture.

From these unassisted efforts at reparation, it is, I think, more than probable, had the fracture been discovered at the time of the accident, and the pelvis and limb prevented from continual motion for a considerable time, that perfect bony union would have taken place, with little or no retraction of the limb.

In the same valuable collection there is a specimen of a double fracture, within, and external to, the capsule; on which Sir A. Cooper, in the appendix to his second edition, lays particular stress. "But the best proof," he says, "of the difference of a fracture within, and one external to, the ligament, is given in a preparation in Mr. Langstaff's museum, in which a fracture has happened within the ligament, and another external to it; and whilst the latter is seen firmly united, the former has undergone no ossific change*."

From reading this passage, I was led to make a very particular examination of this preparation, and the inferences which I draw from such examination are very different from those at which Sir Astley has arrived. In

* Appendix, p. 573.

the first place, I observed that the fractured surfaces within the articulation were very accurately opposed to each other, and consequently that very little shortening could have taken place. Secondly, I perceived, that very firm ligamento-cartilaginous union had taken place, not merely round the edges of the fracture, but between the whole broken surfaces. Thirdly, it was evident, that a considerable portion of the reflected membrane was not torn through. Fourthly, it appeared very clear, that as the fracture within the articulation would prevent the motions of the pelvis from being communicated to the fracture external to the capsule, consequently no comparison can be drawn between the two fractures, as the one within the articulation was liable to participate in every motion of the trunk and pelvis, whilst that external to the capsule was, from the very circumstance of the double fracture, in great measure secured from any such interruptions to bony union. The strong ligamentous union, which is evident from the whole fractured surface, must, I conceive, have called for as much increased action as a similar deposit of bone would

have required: for I am not aware, that the deposition of bone requires more energy than that of ligament.

Thus, then, we find, that dissection and observation confirm what reasoning on the structure of the part would lead us to anticipate, viz. that fractures within the articulation are not attended with much retraction, whilst those external to it admit of being drawn up to a great extent, in consequence of the want of support of the capsular ligament, and the degree of irritation to which the muscles are subjected from the broken spicula. If this does not constantly obtain, the instances are sufficiently numerous to form exceptions to the general rule laid down by Sir Astley, which he advances as a diagnostic of the nature of the accident.

I have been induced to dwell upon this subject, because those surgeons who coincide with Sir Astley Cooper, in believing that union cannot take place within the articulation, would often be led to abandon cases, which even he admits are capable of bony union, under the erroneous impression, that, where much shortening exists, the fracture is within the capsular ligament.

Before I close this part of the subject, it will be right to state, that in old neglected cases, where no union has taken place, there will often be very considerable shortening, in consequence of the absorption of the neck within the articulation; but this, of course, requires considerable time, and does not at all militate against the general position which has been laid down.

In conclusion, I may observe, that speculations on the exact seat of the fracture will, I believe, very often lead to error, as it must require a much nicer discrimination than falls to the lot of most men, and a far greater freedom of examination of the affected limb, than can ever be warranted, to enable us to pronounce with any degree of accuracy. To those who believe that bony union cannot take place, a wrong inference may lead to very injurious practice; and to those who entertain an opposite opinion, such inquiries are useless, as of course they will be induced to treat every case to the best of their abilities, and, in all, endeavour to obtain union without deformity.

When any considerable shortening has taken place, it will be accompanied by ano-

ther symptom, namely, a remarkable increase in the bulk of the thigh at its upper and anterior part, arising from the contraction of the muscles, in consequence of the approximation of their two extremities. In such cases, also, the trochanter major will project more than that in the healthy limb.

The position of the limb is the next circumstance of importance to be attended to, which has given rise to much altercation, and great variety of opinion. We find it observed by Parey and Petit, that the knee and foot are turned a little in. Other authors say that the contrary always takes place, which they attribute to the action of the rotators of the thigh. Both these positions may obtain, but the turning out of the foot is the most frequent. Desault computes the number of cases in the proportion of eight to two. This position of the limb is, perhaps, rather to be referred in the first instance to the laws of gravity, than to the action of the muscles; yet, when once roused into action, the powerful rotators outward would, no doubt, contribute to maintain this position. The thigh-bone may be considered as a lever of the first order, the point of resistance to

thigh

which is in the acetabulum. When this opposition is removed by the giving way of the neck, the lever remains uncontrolled, and the weight of the foot, increased by that of the bed-clothes, naturally carries it to that side to which it is at the time inclined. When the foot is turned out, the knee is a little bent, and the leg is rather drawn up, so as to apply the heel of the affected limb to the hollow between the internal malleolus and tendo achillis of the other side.

In addition to these several diagnostic marks of fracture, Sir Astley Cooper considers the period of life at which these accidents occur, as characterizing the nature of the accident, and even influencing the situation of the fracture.

“ To the circumstances I have already mentioned,” he says, “ as strongly characterizing this accident, must be added the period of life at which it usually occurs; for the fracture of the neck of the thigh-bone within the capsular ligament seldom happens but at an advanced period of life, and hence has arisen the great confusion with respect to the nature of this fracture;

for we find that surgeons of the highest character, and names that will descend with veneration to posterity, have confounded fractures external to the capsular ligament with those we are now describing, and mentioning them as occurring at a period of life in which they never happen*.”

At a subsequent part, he says, after enumerating the marks of similarity between the two accidents of fractures external to, and within the capsule, “ But still there are many distinguishing signs: first, this accident occurs frequently at the earlier periods of life, for it happens in the young, and in the adult under fifty years of age. I have known it at a later period of life, but less frequently; therefore, when the above symptoms are seen at any age under fifty years, it will be generally found to be a fracture external to the capsular ligament, and capable of having ossific union produced in it. Secondly, these cases may be also, in some measure, distinguished by the severity of the accident which produces them; whilst the internal fracture happens from very slight

* Sir Astley Cooper on Fractures and Dislocations, p. 122.

causes, this, on the contrary, is produced either by severe blows, from falls from a considerable height, or from laden carriages passing over the pelvis*.”

Much stress is laid upon this circumstance of the period of life; and Sir Astley even conceives, that inattention to this has been the great source of the difference of opinion, which has hitherto existed relative to the possibility of union. This, indeed, forms the chief basis on which he founds his doctrine of non-union at an advanced period of life; because the fracture is then within the articulation, but at an earlier period it is external to it. This circumstance, with the nature and extent of injury inflicted, and the degree of shortening, are the principal characteristic marks which influence his opinion on this important subject. Let us now examine the evidence he has advanced in support of the two former diagnostics; the degree of retraction has been already disposed of.

In the first place, I would remark, that it is singular that the cases which Sir Astley has published in illustration of the above positions, on which he hinges so much

* Page 146.

weight, are not the result of his own practice and investigation; and secondly, that they do actually, in every respect, contradict the opinions he has advanced.

The first case presented to him, by Mr. Powell, of the Strand, occurred in "a woman, named Mary Clements, *aged 83 and a half years*, who, when walking across her room, supported by her stick, which, from the debility consequent upon old age, she was obliged to employ, unperceived by herself placed her stick in a hole in the floor, by which her balance was lost, and, tottering to recover herself from falling, *which she would have done but for those near her*, she found that she had, as she supposed, dislocated her thigh-bone. When called to her, she was lying upon her bed, in much pain, with the thigh *shortened*, and the foot everted."

A detail of the treatment of the case follows, from which it appears, that she was bed-ridden until the period of her death, which took place fifteen months after the accident. "On dissection, it was apparent that the neck of the thigh-bone had been broken at its junction with the body of the bone, and had been forced into the cancellated structure between the trochanter major

and trochanter minor, where it had united with the cancelli." The other circumstances mentioned in the dissection do not bear upon the present question.

Here, then, we have the case of a woman, aged eighty-three and a half, who breaks the neck of her thigh-bone near the trochanter, by a slight slipping of her foot, without even falling to the ground, brought forward as the first and most prominent case, to prove that this accident occurs *at an early period of life, and is the result of severe injury*; whilst, on the other hand, internal fracture is the consequence of very slight injuries in very old persons.

But let us examine what other evidence is brought forward in support of this theory. The next case occurred to Mr. Wray, of Fleet Street. "A man, *aged 64*, was standing by his bed-side, when he suddenly fell to the ground, as it was supposed, in a fit, and when he was attempted to be raised he was found unable to stand. Mr. Wray found his right leg *shorter* than the other, and everted. The man died on the fourth day; and on examination great extravasation of blood was found external to the muscles and be-

tween them, suppuration had commenced near the trochanter, and a fracture was found at the neck of the thigh-bone and in the trochanter, by which the neck had been received into the cancellated structure of the shaft of the bone."

A third case is adduced, which occurred in Mr. Travers's practice. "A man, *aged* 60, fell on the curb-stone of the foot pavement. A comminuted fracture of the trochanter and cervix femoris were suspected, and the case treated accordingly; the fracture united with some shortening of the limb. The man's health was much deranged, and he died when on the point of quitting the hospital, nearly four months after the accident. The fracture was discovered, after death, to have extended through the trochanter some way down the bone, and it *apparently* had united; but, on maceration, the head and neck of the bone became loose in the thigh-bone, and a fracture was found there, which locked the head and cervix in a shell of bone formed round them."

And this is all the evidence adduced to prove *that fractures external to the capsule*

occur in early life,—that they are the result of great violence, — that they are not shortened,—and that they are capable of ossific union; and upon this testimony the profession are called upon to admit Sir Astley Cooper's easy and decisive solution of all the difficulties which have involved this question,—a solution brought forward to explain the errors of many deservedly esteemed practitioners. I cannot but suppose that Sir Astley Cooper does possess other, and less questionable proof of his position; yet it is to be regretted that he should have suffered another edition of his work to go to press with such apparent contradictions. The high respect I entertain for that gentleman renders it most painful to me to point out these passages; but the duty I owe to the public and my profession, is paramount to every other consideration.

As a general maxim, I think we may be warranted in stating, that fractures of the neck of the femur, both within and external to the capsule, occur most frequently in advanced life, and in a large majority of cases to females; and a little reflection will point out many circumstances which contribute to

this. The vacillating steps of age render such persons more liable to falls; the effect of which, their want of spring and inactivity prevent them from counteracting, consequently they fall with a more dead weight. The gradual alterations which take place in the intimate structure of the bony fabric, which have been already alluded to, render their bones more friable, and less capable of resistance. In the female, the greater prominence of the trochanter major, in consequence of the breadth of the pelvis, causes this part to be particularly obnoxious to injuries. But, although it must be acknowledged that fractures of the neck of the femur occur most frequently to aged persons, it does not, by any means, follow, that such accidents should not occur at an earlier period of life, not only within, but external to, the capsule. The cases adduced by Sir Astley, which have been already quoted, show, that fractures on the outside of the capsule, and fractures of the trochanter, do occur in advanced life in consequence of very inconsiderable injuries. Boyer relates similar cases. The most complicated case of fracture external to the capsule,

related by Mr. Colles, occurred in a female above eighty years of age: and the same gentleman adduces two cases, in which only cartilaginous union had taken place in fractures external to the capsule. Lastly; my own experience has furnished me with several instances of complicated fractures of the trochanter, and fractures external to the capsule, in persons greatly advanced in life: whilst, on the other hand, I have had opportunities of examining, post mortem, three cases in which fractures had occurred within the articulation in young subjects: in all which instances the fractures were the consequence of violent injury.

The question, then, resolves itself simply into this: Is there any thing in the structure of the neck of the thigh-bone within the capsule, which renders it unsusceptible of fracture at an early period of life? The answer is, that experience proves that it may be broken at any period, provided the force be so directed as to bear particularly upon this part. Sir Astley Cooper has indeed stated, in common with Ruysch and some other authors, that the same violence which produces dislocation in an adult occasions fracture in old age.

This explanation appears very specious ; but can it be borne out by facts or arguments ? Does the same force which produces fracture ever cause a dislocation ? I firmly believe not : for it is applied in such a direction as to have no tendency to displace the head of the bone. It is rather extraordinary, that, in the very next page, Sir Astley Cooper should dwell at some length on the very slight causes which may produce a fracture, and particularly he mentions trifling falls on the trochanter. I would only appeal to the candour of that gentleman to state, whether he ever, in the whole course of his extensive experience, knew of so slight a cause, and a force so directed, productive of a dislocation of the thigh in a young, or indeed in any person ? I would willingly consent to let the issue of the present question be decided by his answer.

Other characteristic symptoms of fracture, besides those which have been enumerated, are mentioned by different authors ; such as the degree of pain produced in rotation and abduction, and the great freedom of motion in the limb : but as I hold all these examinations to be worse than useless,

and productive of great present suffering, and much consequent injury, I forbear to enter into any particular account of them.

The indications which have been laid down are sufficient to point out the nature of the accident to any one conversant with the subject, and acquainted with the anatomy of the parts. As, however, errors have occurred in practice, and these cases have been confounded with dislocations, the consequences of which must be equally injurious to the reputation of the surgeon, and the welfare of the patient, I shall briefly point out the distinguishing characters of the different species of dislocations, and contrast them with those of fracture.

The head of the thigh-bone may be displaced in four different directions : — On the dorsum ilii, on the ischiatic notch, on the foramen ovale, and on the body of the pubes. Only the first and second situation require to be considered ; for, when the bone is displaced downwards on the foramen ovale, the limb is lengthened, which precludes the possibility of any mistake ; and when forwards on the pubes, the direction of the limb bears no analogy to what occurs in

fracture; and the head of the bone can be easily detected beneath the integuments, resting on the pubes. In dislocation on the dorsum ilii, which is the most common direction, the following symptoms may be remarked:—the thigh is considerably shorter than the other, is bent, and carried inwards; the knee is also bent, and turned forwards and inwards; the leg and foot are in the same direction, so as to apply the sole of the latter over the tarsal arch of the opposite foot. The trochanter major is brought nearer the anterior superior spinous process of the ilium, is elevated, and stands more forward; whilst at the same time it is less prominent laterally than the opposite limb, which causes a flatness on the affected side. This position is permanent; any attempt to turn the limb out causing great pain, and not being attended with success. The length of the limb cannot be restored until a reduction of the thigh has been effected. On inquiring into the history of the case, we generally find that the accident has been produced by some heavy blow or fall, whilst the limb was turned inwards; and invariably the full degree of retraction is immediately

consequential to the receipt of the injury. There is another kind of dislocation of the femur in the direction upwards, of very rare occurrence, when the head of the bone is so situated on the dorsum ilii that it is anterior to the trochanter. I have never witnessed a case of this nature, and shall, therefore, borrow the description from Mr. S. Cooper's valuable dictionary. "This case," he observes, "deserves very particular attention; because, being attended with a considerable turning out of the toes, and shortening of the limb, it is likely to be mistaken for a fracture of the neck of the femur. The case, however, is not difficult of detection, for you can feel the head of the bone projecting forwards on the ilium."

I have lately had some conversation with my friend, Mr. S. Cooper, on the subject of this dislocation, and I find that he never met with more than one instance of this kind. The more frequent, and nearly constant, occurrence of the displacement of the head of the bone backwards, which is accompanied with rotation of the member inwards, has been usually ascribed to the circumstance of the lower and inner portion

of the capsular ligament remaining entire, and keeping the fore-part of the trochanter major close to the acetabulum*.

To this cause might be added the connexion of the tendons of the psoas magnus and iliacus internus with the trochanter minor, which must have been ruptured in the case related by Mr. S. Cooper; as it is hardly possible that they would have yielded to so great an extent as they must have done, supposing that they retained their connexion with the trochanter minor in the position described by that gentleman.

In this case, also, the full degree of retraction and lameness would immediately follow the accident.

The dislocation backwards and upwards into the ischiatic notch, approaches nearest to the position of fracture of the neck, and is also the most difficult displacement to detect and reduce. The following is the description of this accident, given by Sir Astley Cooper:—"The signs of this dislocation are, that the limb is about half an

* Vide Delpech, Précis Elément. des Mal. Chir. tom. iii. p. 112.

inch to one inch shorter than the other, but generally not more than half an inch; that the trochanter major is behind its usual place, but is still remaining nearly at right angles with the ilium, with a slight inclination towards the acetabulum. The head of the bone is so buried in the ischiatic notch, that it cannot be distinctly felt except in thin persons, and then only by rolling the thigh-bone forwards, as far as the comparatively fixed state of the limb will allow: the knee and the foot are turned inwards, but not near so much as in the dislocation upwards, and the toe rests against the base of the great toe of the other foot. When the patient is standing, the toe touches the ground, but the heel does not quite reach it. The knee is not so much advanced as in the dislocation upwards, but it is still brought a little more forwards than the other, and is slightly bent. The limb is fixed; so that flexion and rotation are, in a great degree, prevented. This dislocation is produced by force being applied when the body is bent forward upon the thigh, or when the thigh is bent at right angles with the abdomen; when, if the knee

be pressed inwards, the head of the bone is thrown behind the acetabulum."

On comparing the history and symptoms of these various dislocations, we shall find that each differs, in some material respect, from those which occur in fracture; sufficiently, indeed, to enable any person conversant with anatomy to decide on its true nature.

When, however, any doubt remains, a strict attention to the following rule will generally remove it. Let the surgeon constantly bear in mind the relation which the head of the bone bears to the trochanter major. These two bodies are placed nearly parallel to each other, the head being rather higher and more forward. In fractures of the neck, accompanied with retraction, the trochanter is drawn nearly directly up: a moment's consideration, therefore, of the relative position of parts, will point out the nature of the accident; it being impossible for the head to be in the situation it must occupy, supposing it to be still connected with the body of the bone.

Prognosis.

THE prognosis of this accident is a point which has been much contested, and is a subject on which the opinions of the Profession are yet at variance. By some authors, more or less lameness is considered as the unavoidable consequence. Hildanus, Ludwig, Platner, Haller, Sabatier, Louis, and John Bell, all agree in this particular. By others it is maintained that bony union is altogether impossible; and there are others who consider these cases as not differing, in any material degree, from common fractures, except in the difficulty of treating them. Amongst the latter may be reckoned Brunninghausen, Seibolt, Desault, Bichat, and Boyer.

In endeavouring to reconcile these discordant opinions, it will be right, in the first instance, to examine in what respect this fracture does really differ from any other, and the reasons that have been advanced in support of the opinion, that union by bone will not take place in this as in any other fracture.

There can be no question that a material

difference does exist between a fracture occurring in the neck and in the shaft of the thigh-bone. When the centre of a long bone is broken, both portions are liberally supplied with blood; as well from the nutrient arteries as from the vessels of the periosteum: but in the present case, when the reflected layers of the fibrous and synovial membranes are torn through, one part is almost deprived of its supply of blood; it can receive none from the smooth articular surface, as that would impede the natural functions of the joint: it must then depend for its nourishment on the vessels it receives through the ligamentum teres, and the synovial membrane reflected over it. This supply, it must be granted, is small, and particularly so in old people, to whom this accident most frequently occurs. To this cause may fairly be referred the length of time required for union; and in some instances, in very old and feeble persons, the quantity may be inadequate to the performance of a function, which requires considerable vigour.

On this principle of a deficient supply of blood, many authors have entertained an opinion, that in no case can bony union

take place within the capsular ligament. The consequence of such a doctrine leads directly to the abandonment of all attempts at restoration; and the unfortunate patients are doomed to lameness and deformity for the remainder of their lives. But, although it must be granted that the supply of blood is small, yet it is sufficient, in early life, to accomplish the complete ossification of the head, which at that period is separated from the shaft of the bone by a thick portion of cartilage, through which no vessels can be traced. It is true that the head does in part receive its supply, in this latter case, through the reflected membranes; and so it would after fracture, provided they were not completely lacerated at the time of, or subsequently to the accident. But even when the head has been completely severed from the neck, it has possessed sufficient powers to maintain its own vitality, as I never yet heard of an instance in which the head had perished for want of nourishment. In some very old cases, of many years' duration, its size has been diminished; but this should rather be regarded as a salutary effort of

nature to remove a part which is of no further utility.

I cannot but consider, that to doubt the possibility of union, even when the head is quite separated from the neck, betrays a want of confidence in the reparative efforts of nature; which is not a little surprising, after the numerous experiments of transplantation of parts by John Hunter, and other eminent physiologists, and the Talia-cotian operations, which have been performed in this and other countries. Surely it is but reasonable to suppose, as the head of the bone possesses sufficient vitality for the preservation of its own life, and the production of granulations, that it is capable of perfect bony union, provided the surfaces are kept permanently in contact, by the inosculation of its vessels into those of the lower portion.

That it is capable of throwing out bony matter, is manifested even in cases which have been quite neglected, by the hard smooth surface which it in time acquires, consisting of a bony deposit over the surface of the cancellated structure of the neck.

This has been said to be the effect of attrition of one part on the other: but friction, although it might wear away a part, would never build up a new structure; which, on the contrary, is the result of an action set up for the purpose of reparation.

Two very fine specimens of this smooth osseous deposit on the surface of the upper portion of bone, are contained in Mr. Langstaff's museum; in one of which the section of the bone exhibited a complete layer of firm bone, closing up the cancellous structure of the neck; and this, again, is invested by a firm and vascular membranous covering.

Mr. Colles gives two specimens of the same appearances. In the two first cases he describes the fractured surface of the upper portion as covered by "ivory-like patches," evidently showing considerable ossifying power in the head of the bone.

But I am contending for the possibility of union when the head is quite severed from the neck. This state, however, will hardly ever exist if the case be from the first properly treated; and if any portion of the reflected membrane remains entire, there will be a direct communication of vessels

between the parts, and the broken surfaces will be retained more closely in contact.

Duhamel, and some authors, have contended, that union does not take place from the want of periosteum. It is only necessary to state, in answer to such objections, that the old opinion that the periosteum could alone pour out callus, is now justly exploded; and it is generally admitted that the broken surfaces of bones are capable of uniting by bone, without the intervention of periosteum: besides, if periosteum were requisite, the reflected layer of the fibrous membrane fully answers the purpose of such a covering.

Borst, in Ruysch's Thesaurus, Platner, Ludwig, and Haller, mention the absorption of the neck of the femur, even that portion attached to the trochanter, as a proof that there is deficient nutrition: but this should rather be regarded as a salutary effort to round off the asperities of the broken bones, and form a new articulation in cases which had been imperfectly treated.

Other authors have stated, that the want of union depended on the synovia mixing with the callus: but I pass over this, and

other objections, to meet those of Mr. John Bell, who contends, that the want of union arises from the insulated state of the head and neck; and conceiving that lameness is inevitable, recommends that laceration, or ulceration, of the capsular ligament should be promoted, to bring the broken bones in contact with parts endued with more vital powers.

In perusing the observations of this author, we meet with so many direct contradictions, that but little confidence can be placed in his statements; which are evidently not the result of observation and experience, but the effusions of one, who, in writing a particular system, endeavours to accommodate facts to support his peculiar opinions; and in the present instance he has done this without much regard to consistency. It is only necessary to compare the following passages, to justify the above criticism. At page 552, line 10, he states:—
 “ When the neck of the thigh-bone is fractured, the capsule sometimes remains entire. The capsule is of an insensible nature, entering very slowly into action; and within that ligamentous and insensible capsule is in-

cluded the whole length of the neck of the thigh-bone. The neck is surrounded with mucous fringes, and the cavity in which it lies is lubricated. The periosteum and ligaments are slow in entering into action, or inflaming even when they are lacerated; but, when they remain entire, they exclude all connexion of the fractured bone with the muscular parts. Thus, unassisted by any of the usual adhesions, the neck of the thigh-bone is left to its own intrinsic powers; naked bone is opposed to naked bone; and not very regularly opposed, for the ends of the fractured cervix are so obliquely placed with regard to each other, that more than the usual callus would be required for their reunion; and yet they are so entirely deprived of any support from the surrounding parts, that less callus is produced, often none, they frequently remain disunited. That the part is bloodless, that the surrounding parts are little able to contribute their share in the cure, is the very truth."

Compare the foregoing passages with the description he gives at page 527, when speaking of dislocation:—"Often the lining of the socket and the root of the ligament

are so thickened by inflammation, that the head of the luxated thigh-bone, though it moves securely in the socket, is a little raised, and the limb sensibly lengthened. These membranes, which involve the bones, although pale and bloodless, are so vascular, that after laceration they always inflame, and often adhere; and so entirely is the head of the thigh-bone nourished and supported by this inverted membrane, that when the neck of the bone is broken away, and the head left in the socket, the head, though apparently insulated and left hanging by its central ligament, *lives, shows strong ossifying powers*, and adheres perfectly to the inner surface of the socket. Then the socket and head of the os femoris become one inseparable mass of bone; and, being thus united together, their ossific power is so great, that they generate a larger mass of callus; and the upper broken end of the thigh-bone resting upon this broad mass of ossifying bone, composed partly of the acetabulum, partly of the fractured head of the bone, gives it, by its pressure, a shape conformable to its own; and this makes a broad but imperfect joint."

I leave the reader to draw his own conclusions, after comparing these two passages from the pen of the same author: any further comment on them would be quite superfluous.

I come now to consider the opinions entertained by Sir Astley Cooper of the causes which influence the want of bony union in fractures within the articulation; and as I have the misfortune to differ from that gentleman, and consider the question of much importance, I shall take the liberty of examining, with critical minuteness, the several objections he has raised; and shall endeavour, by arguments and facts, to prove that the ground on which these objections are raised is not tenable.

After stating, that he never met with a single instance of bony union of the cervix femoris within the capsule, and his firm conviction, that such cases must be attended with more or less lameness, Sir Astley proceeds to state the causes which he conceives contribute to produce this effect: and first he mentions the want of proper apposition of the broken ends;—"for if the broken extremities in any part of the body be

kept much asunder, ossific union is prevented*.”

I am perfectly willing to admit, that, in the present case of fracture of the neck of the femur, if the broken surfaces are kept much asunder, that firm ossific union cannot take place; because the broken ends of the bone would not only be kept asunder, but one would be so much more elevated than the other, that no production of callus could ever effect an union whilst they were in that unnatural position: but if their proper relative position be restored, and that position be steadily maintained, which I hope to prove may very easily be accomplished, this objection no longer holds good. It can only be considered as a cause of non-union, on the supposition that the broken bones cannot

* The correctness of this statement, as a general position, is very questionable: the cases recorded by Mr. Dunn, in the 12th volume of the Medico-Chirurgical Transactions, clearly prove the possibility of bony union after the removal of three inches of the tibia, and the consequent separation of the bones to the extent of two inches. In Mr. Heaviside's museum, and in other anatomical collections, may be seen many similar instances of extensive bony deposits between fractured surfaces that were not in apposition.

be brought into the same line of direction, and kept in that position.

Sir Astley Cooper has endeavoured to anticipate these observations in the following passage*.—"But if this were the only obstacle, it would be argued that the retraction of the thigh-bone might be prevented by bandaging and extension; *and the truth of this cannot be denied; but it is extremely difficult to preserve the limb in this position, as the patient, in evacuating his fæces and urine, or by the slightest change of position, produces instant contraction of the limb*, by calling into action those powerful muscles which pass from the pelvis to the thigh-bone."

Sir Astley might have added, that in these slight motions the superior or pelvic extremity of the broken bone is liable to perpetual disturbance: and to this cause, more than the supposed action of muscles, is the want of union to be referred. Here, however, we have a candid confession, that this first cause of non-union, namely, want of adaptation, does not depend so much on any insuperable obstacle arising from the

* Page 129.

nature of the case, as on the difficulty of treatment. Surely, then, it is our duty, instead of abandoning such cases as incurable, to endeavour to remove this opprobrium from our profession, and, by superior means, meet the exigencies of the case.

The next objection which is raised, is the absence of continued pressure. "The second reason," says Sir Astley Cooper, "which prevents a bony union in these fractures, is the want of pressure of one bone upon the other, even where the length of the limb is preserved; and this will operate in preventing an ossific union in cases where the capsular ligament is not torn; and in all those which I have had an opportunity of examining, it has not been lacerated. The circumstance to which I allude, is the secretion of a quantity of fluid into the joint: from the increased determination of blood to the capsular ligament and synovial membrane, a superabundance of serous synovia, that is, synovia much less mucilaginous than usual, distends the ligament, and thus entirely prevents the contact of the bones, by pushing the upper part of the body of the thigh-bone from the acetabulum. After a

time this fluid becomes absorbed, but not until the inflammatory process has ceased, and ligamentous matter has been effused into the joints from the interior of the synovial membrane."

In bringing forward this reason for non-union, Sir Astley does not state whether this increased quantity of synovia has been actually found so distending a joint as to separate the broken bones; and as death soon after the accident is not an usual occurrence, and this fluid, he says, is subsequently absorbed, it is more than probable that this fact requires the confirmation of actual observation. It is, however, reasonable to suppose, that after such an injury, and more particularly if the limb be much handled and examined *secundum artem*, that such effusion would take place. In the case of Spelling, which I have related above, at page 30, this did take place: and in the other two instances I have examined, there was more synovia of a reddish colour than was natural; but in neither of these instances did this fluid separate the broken bones; nor can I conceive it possible that such should be the result of the greatest possible distention that

the capsule is capable of sustaining;—on the contrary, such distention must have the effect of bringing the bones more closely in contact. To illustrate this, and place it in the clearest point of view, we will suppose an oblong bag rather loosely applied over a cylindrical portion of wood, and firmly fastened at the distal ends of the same; then let the wood be divided transversely near its centre, and the loose state of the bag will in that case admit of a certain degree of separation between the two portions: but distend the bag with fluid, taking care to keep the divided ends of the wood in their proper relative situation, and it will be proved to demonstration that the two pieces of wood will be brought into contact with each other; and the greater the degree of distention, the closer will be the contact to which they will be brought; because the process of distention will have the effect of expanding the sides of the bag, which alone can yield to the pressure of the fluid, and consequently of approximating its two ends; which being fastened to the distal ends of the two pieces of wood, must force their divided surfaces into closer contact. Now, if this will take place in the

supposed case of illustration, it will, *à fortiori*, take place in the case of the hip-joint; for the capsular ligament is not, like the supposed bag, loose in its whole circumference, but is, in fact, closely applied to the neck at its upper part, where it is most powerful and unyielding: and although it may become relaxed when retraction has taken place, yet, if the bones be in their proper relative situation, and the thigh bent on the pelvis, it will of itself be so completely distended as to bind the broken portions together with considerable strictness, without requiring the further aid which would be afforded by the distention of fluid.

The third and principal reason assigned by Sir Astley Cooper for the want of union, is the absence of ossific action in the head of the bone when separated from the neck; its life being then solely supported by the ligamentum teres, which has only a few minute vessels ramifying from it to the head of the bone. I have, in great measure, anticipated my reply to this reason, which is the common one adduced by all the authors who have advocated non-union: I will, therefore, only state further, that Sir Astley himself acknow-

ledges that "there may be some exceptions where the thigh-bone might be broken without the strong sheath of the periosteum and reflected ligament which surrounds it being torn; and under such circumstances, if they ever were to happen, ossific union might proceed: but in that case the usual shortening of the limb would not occur."

I feel particularly happy in being able to concur in this particular with Sir Astley, and in adding my testimony to prove, that such a circumstance is not only possible, but has occurred to my knowledge: and further, I most firmly believe, that it does occur in a large majority of instances: but I have dilated sufficiently on this point in a former part of these observations.

One word more respecting the vital powers in the insulated head of the bone. Sir Astley Cooper, in common with many other authors, acknowledges, what indeed every anatomical museum will prove, that the head of the bone not only lives, but is capable of throwing out ligamentous bands, and uniting by these with the neck of the bone, even when not closely adapted. Now,

if it be capable of this soft union under all these unfavourable circumstances, may we not reasonably expect that perfect bony union would take place if the broken surfaces were closer in contact, and steadily maintained in that situation? For the vessels of the bone are accustomed (if I may use the expression) to the deposition of osseous particles, and only substitute ligamentous matter in consequence of the continual disturbance of the fractured portions. Precisely similar would be the result of a fracture in any other bone, provided that the broken surfaces were subjected to daily, and almost hourly, disturbance.

And here I may state my firm conviction, that it is in the great mobility of the upper portion of the bone, which partakes of the slightest movements of the trunk and pelvis, that all the difficulty in the proper treatment of these cases depends; and the little attention which has hitherto been paid to restrain this free motion, is the great, if not the sole cause, of non-union, or union by ligament. The defect has been in the mode of treatment, not in the powers of nature; and sur-

geons have arraigned her laws to account for their own neglect and inattention.

I am aware that it may be urged in opposition to this opinion, and I am therefore anxious to meet the objection, that if this constant motion in the broken part were the principal cause of the want of bony union within the capsule, the same rule ought to hold good with respect to fractures external to the capsule, which do admit of bony union. In answer to this, I would observe, that the cases differ widely in many respects: the neck, when broken within the articulation, is nearer to the head of the bone, and therefore more liable to be moved; it is contained within a synovial membrane, and unsupported by any surrounding soft parts immediately applied to the broken bones; and consequently susceptible of perpetual variation of position with every slight motion of the pelvis and trunk. From the oblique position and deeply seated situation of the neck, no adventitious support can be brought to bear directly upon the fracture; and from the fracture occurring in the very axis of rotation, where every motion of the

lower extremity centres, no alteration of position in the leg or thigh can take place without a corresponding movement in the neck of the bone.

On the other hand, in fractures external to the capsule, the fracture is generally more oblique, and presents a larger surface for coaptation ; it is frequently complicated with fracture of the trochanter, and the neck is generally driven into the cancellous structure at the root of the trochanter, which tends much to restrain its motion ; the broken part is further removed from the centre of motion, and is surrounded immediately by muscles and parts endued with a higher degree of vital powers, which soon inflame and throw out gelatinous matter, which becomes organized, and affords support to the fracture. The fracture is also more under the control of the surgeon, and more capable of receiving support from splints and bandages. The rotation of the leg and foot has not so injurious an influence over this fracture as when within the articulation ; and though it may cause the limb to unite with the foot turned out, it does not remove the broken surfaces

so much from each other as when within the joint, where the points of contact are more limited.

In the second place, I would remark, that fractures external to the capsule very generally unite with much superabundant callus, arising probably from their being frequently disturbed; and in many instances the union is not bony, but of a ligamentocartilaginous nature. Of this there are two instances recorded by Mr. Colles; and Mr. Travers's case, related by Sir Astley Cooper, admitted of motion between the broken surfaces.

Sir Astley Cooper, it is true, affirms, that he has never met with union by bone within the articulation, but that he has when the fracture was external to it. As many of Sir Astley's patients must have escaped any post mortem examination, the facts, in many instances, must rest upon his assertion; and as the diagnostics which he has advanced of the two cases appear to me to be incorrect, as indeed I have endeavoured to prove, it is quite legitimate to suppose that in some instances he may have treated one case for the

other ; and as, under the supposition of fracture external to the capsule, he would endeavour to favour the union by rest and extension, it is by no means improbable that he may occasionally have succeeded in obtaining bony union without being aware of his success.

That Sir Astley Cooper may not in general have succeeded in obtaining bony union within the articulation, I can perfectly understand, from his own description of the accident, from the mode in which he has been led to view the case, and the treatment he recommends to be adopted. As I am now contending for a very opposite doctrine, I must rely on that gentleman's candour to excuse my making very free with his publication, and openly and candidly stating my objections. I might have done this under the mask of an anonymous reviewer, and thus have escaped the responsibility I am now incurring ; but it is more consistent with my feelings, openly to avow my opinion of the causes of his want of success.

First, then, I believe, that, in many instances of fracture within the capsule, the

examinations, to which Sir Astley recommends that patients should be subjected, may have ruptured the remaining portion of the reflected layers of fibrous and synovial membrane, and thus have not only tended to insulate the head of the bone, but to increase the irritability of the surrounding muscles, and to create considerable inflammation in the synovial membrane. After describing the various directions in which the limb may be moved, and the different degree of pain produced by these various manipulations, he proceeds thus:—

“ In order to form a still more decided judgment of this accident, after the patient has been examined in the recumbent posture, let him be directed to stand by his bedside, supported by an assistant, so as to bear his weight on the sound limb; the surgeon then observes most distinctly the shortened state of the injured leg, the toes rest on the ground, but the heel does not reach it; the knee and foot are everted, and the prominence of the hip is diminished*.”

These indications are not, however, suffi-

* Page 121.

cient to satisfy Sir Astley, and therefore he proceeds thus :—

“ On *ordering* the patient to attempt to bear upon the injured limb, he finds himself incapable of doing so without considerable pain, which seems to be produced by the psoas, iliacus, and obturator externus muscles being put upon the stretch in the attempt, *as well as* by the pressure of the broken neck of the bone against the interior surface of the capsular ligament, and there will be a greater or less projection of the trochanter, proportional to the length of the fractured cervix femoris attached to it. A crepitus like that which accompanies other fractures might be expected to occur in these accidents, but it is not discoverable when the patient is resting on his back with the limb shortened; but if the leg be drawn down, so as to bring the limbs to the same length, and *rotation be then performed*, the crepitus is sometimes observed from the broken ends of the bone being thus brought into contact, but the rotation inwards most easily detects it.”

Now, if the generality of Sir Astley's patients, and particularly those in Guy's

Hospital, have had all these indications of fracture demonstrated upon their persons, it is not difficult to understand the great degree of shortening of the limb, and destruction of the fibrous periosteum, which he has found in fractures within the capsule. I have already commented on the worse than inutility of such examinations in another part of this work, and only revert to the subject to explain one source of failure in Sir Astley's practice.

The next circumstance is the prejudice which he acknowledges has existed in his mind for the last thirty years on this subject, which may fairly be supposed to have prevented him from making any very effectual attempt to remove the difficulties attending the treatment, the greatest of which he acknowledges to be the securing the pelvis during the operations of nature. So very far indeed has this prejudice carried him, as to induce him to express himself in the following strong language:—"It is gratifying to find opinions, which have been *for thirty years* delivered in my lectures, confirmed by the observations of intelligent and observing persons; and *therefore it was with*

pleasure I read the account of Mr. Colles of Dublin*, who found a similar want of ossific

* In drawing these inferences from Mr. Colles's paper, Sir Astley will, I conceive, hardly be borne out by the facts recorded, as I think will be very apparent by referring to the paper in question, in which Mr. Colles has given an account of eleven dissections, of which the following is an abstract:—

No. 1.—A dissecting-room subject; fracture through the cervix near the trochanter, no union, but superior surface covered with a substance resembling ivory. This case proves the strong ossifying powers in the detached head, which could produce this ivory-like substance; and as nothing is known of the treatment, no conclusion can be drawn respecting the powers of union.

No. 2.—No mention respecting the accident or treatment, from which I conclude it was a dissecting-room case. Appearances exactly similar to the first case, viz. ivory-like patches over the broken surface.

No. 3.—Also a dissecting-room subject: fracture through the cervix, close to the acetabulum. Strong ligamentous union between the posterior surfaces, which were also connected with the capsular ligaments. As nothing is known of the treatment, no conclusion can be drawn from this case.

No. 4.—A dissecting-room subject: a transverse fracture on a level with the acetabulum; posterior third of the upper fractured surface covered by the solid plate of bone which invests the neck of the femur, which was now softened, folded in, and *laid down on the fractured surface of the head, to which it was united*. No proof of the want of powers of union can surely be drawn from this case.

union in fractures within the capsule." It would, I humbly conceive, have been some-

No. 5.—A woman, eighty years of age, was received into the hospital with fracture. From the pain she suffered she was unable to remain quiet, and the fracture was constantly disturbed. On dissection, there was found a very complicated and comminuted fracture of the trochanter and cervix external to the capsule. This case proves most clearly the possibility of a very extensive fracture external to the capsule, occurring at the advanced age of eighty years.

No. 6.—No mention of the nature of the accident or treatment; probably a dissection-room subject. A transverse fracture close to the head; neck nearly absorbed in front, and the head of the bone, on a level with the top of the trochanter; the fractured pieces were connected together by a ligamento-cartilaginous substance, of considerable thickness and strength, particularly at the superior part, where *the reflected membranes were not torn*. It is more than probable, had this case been treated with uninterrupted rest from the first, that bony union would have taken place.

Nos. 7, 8, 9, I must confess myself unable to comprehend; unless, indeed, the appearances were the result of diseased action within the joint. I have read them with much attention, but do not clearly understand their nature.

In No. 7 it appears "that the fracture was transverse," and yet he observes that it was incomplete; for the external bony coating of the neck of the femur remained unbroken for nearly half the circumference of the bone at its posterior part, and was reduced to the softness and whiteness of cartilage. No. 8 was a *similar*

what more gratifying to have found that this opprobrium had been removed from our profession, and that the deformity, lameness, and misery of our patients had been diminished or prevented.

This strong bias has, indeed, evidently influenced the practice which Sir Astley recommends to be pursued, and which is the third source of his want of success. This consists in the placing a pillow under the whole length of a limb, and another rolled up under the knee, and thus extending the limb for ten days or a fortnight; at the end

transverse incomplete fracture, with morbid alteration in the texture of the bone and membrane. No. 9 was of a similar nature. Nothing conclusive, either pro or con, with reference to the question of union, can be drawn from either of the three cases.

No. 10 was an adult dissecting-room subject, exhibiting a fracture *external* to the capsule, which was driven into the cancellous structure of the trochanter major; and had there united by the intervention of a *blue cartilaginous substance*, which admitted of motion between the fractured surfaces.

No. 11 was a similar case; also united by a *thin cartilaginous plate*. Neither of these cases can be quoted to prove the want of union within the capsule, nor can they be brought forward in support of the possibility of bony union external to it.

of which period the patient is to rise daily, and sit up in a high chair, to prevent any painful flexion. "Our hospital patients," he says, "treated in this manner, are allowed in a few days to walk with crutches; after a time a stick is substituted for the crutches, and in a few months they are able to use the limb without any adventitious support*," but of course with the limb shortened for the remainder of their lives. When the fracture is ascertained to be exterior to the capsule, he adopts a different practice.

It must be very apparent, that under such treatment no patient can recover without lameness, and that ossific union is quite impossible. How long he has adopted this plan of treating, or, more properly speaking, of abandoning patients, he does not state.

With respect to the different treatment adopted in fractures external to the capsule, I shall consider the plan recommended under the head of treatment; at present I am only anxious to point out what I conceive to be the real causes of the want of union which has attended Sir Astley's practice; and I will only add here, that it is *very dangerous to lay*

* Page 144.

down such different plans of treatment for accidents so nearly resembling each other, and so likely to be confounded even by men of extensive experience. Such an attempt at distinction can only lead to the most injurious consequences.

I come now to consider the experiments on animals, which Sir Astley instituted for the purpose of ascertaining the truth of his opinions respecting the want of union within the capsule.

The first experiment was on a rabbit. "The neck of the thigh-bone was fractured on October 28th, 1818; and as the wound had been some time healed, the animal was destroyed on the 1st of December.

"*Appearance on dissection.*—The capsular ligament was much thickened, the head of the bone was entirely disunited from its neck, but adhered by ligament to the capsular and synovial membranes. The broken cervix, which was very much shortened, played on the head of the bone, and had smoothed it by attrition; the head of the thigh-bone had not undergone any ossific change.

"*Experiment 2d.*—The neck of the thigh-bone was broken in a dog, Nov. 12, 1818,

and the animal killed on the 14th of December following.

“ *Dissection.*—The trochanter was much drawn up by the action of the muscles, so that the head and cervix were not in apposition. The capsular ligament was much thickened, and contained a large quantity of synovia*.”

It is necessary to observe, with respect to these experiments, that, in the first place, in order to accomplish the separation of the neck of the bone, it was necessary to open the capsule, and thus to make a compound fracture in a joint in lieu of a simple one:—next, that the reflected membranes were entirely severed, and the head perfectly insulated;—thirdly, that no precautions whatever were taken to prevent the constant and free motion of the broken bones, which was so great as to have smoothed the broken cervix by attrition in the course of only one month from the infliction of the injury.

Surely these results might have been anticipated: for how is it possible, that, under such circumstances, union could have taken

* Pages 136, 7, and 8.

place? Nothing short of a miracle could have effected it. If Sir Astley could have broken the bones without opening the joints, and afterwards amputated the limb so high up as to have prevented all motion in the broken part, the experiments would have been more conclusive; but I much doubt whether it would not have been favourable to the possibility of ossific union. As it is, these experiments literally prove nothing at all, but what every one at all conversant with the animal economy might have completely predicted.

A third experiment is detailed, in which the neck and head of the thigh-bone of a dog were divided longitudinally, by placing a knife on the anterior part of the trochanter major, and striking it down towards the acetabulum. The animal was killed twenty-nine days after, and the following appearances presented themselves:—A portion of the trochanter major had been broken off, and was *only united by cartilage*; the head and neck of the bone, which had been longitudinally broken, were united, but the neck was joined by a larger quantity of ossific deposit than that which joined the separated portions

of the head of the bone, and so irregularly as to make a beautiful preparation, and shows the circumstance most clearly.”*

From this experiment Sir Astley Cooper draws the following inferences : — “ That, in a longitudinal fracture of the head and neck of the bone in parts external to the ligament, if the bones be applied to each other, pressed together, and in a state of rest, ossific union can be produced, although the ossific deposition is extremely slight when compared with that of other bones.”

This experiment is certainly very satisfactory in proving that, even after a compound fracture, union within the articulation will take place, provided the broken bones are kept in contact. And I cannot but regard it as highly encouraging to persevere in endeavouring, in all cases of fracture, to keep the bones in the closest possible apposition, and in a state of rest.

I cannot, however, view the case in the same light as the author of it ; for it is very apparent that a portion of the head and neck were *completely severed from the rest of the bone, without even the connecting*

* Page 139.

medium of the ligamentum teres; and yet this insulated portion of bone was not only capable of receiving nutrition from the other portion of the head and neck of the bone, but actually of ossific union. Surely, then, it is not too much to suppose that the head of the bone, which every one acknowledges has sufficient vitality to form adhesions with the surrounding parts, and ligamentous union with the neck, is capable of ossific union under circumstances of more complete adaptation, and the necessary state of rest, even when the neck is completely severed from the head. When the reflected periosteum is not torn through, even Sir Astley admits the possibility of such an occurrence.

But it may be urged, that I have hitherto only adduced arguments in opposition to the reasons which have been assigned for the want of bony union, and that the *onus probandi* rests with me to show that bony union has taken place. It is not sufficient, it may be said, to point out the circumstances which have hitherto interrupted the union by bone, but I must prove that ossific union has actually taken place.

That such an occurrence, without any lameness, or perceptible shortening of the

limb, has happened several times in the course of my experience, I am perfectly satisfied of in my own mind; but as the individuals are either now living, or have died without affording me an opportunity of ascertaining the actual state of their limbs, I cannot reasonably expect to gain implicit credence to all the testimony which I might offer upon this subject. By actual dissection, however, I have proved the possibility of fracture existing without the periosteum and synovial membrane being completely torn through. By dissection, also, I have proved that union has taken place within the capsule, and that so firm and rigid, as to be inseparable even after maceration, and which required boiling for a considerable time before it could be overcome.

The following are the particulars of the case in which this occurred:—One of the nurses belonging to the hospital, aged 74, was knocked down in the street by a horse, and fractured the neck of the thigh, in the year 1808. She was an old emaciated woman, and had been much addicted to drinking. I did not attend her until nearly three weeks after the accident, when I found the limb re-

tracted and foot everted. Very little attention had been paid to her during this interval. By gentle and continued extension I drew down the limb nearly to its proper length, when a very evident crepitus was perceptible. The limb was maintained in this situation by means of a splint, of a peculiar make, which I had constructed for cases of this description, and which I shall mention hereafter. The patient was placed on a double bed, which admitted of her passing her motions without moving the pelvis. She was kept in this position for seven weeks, when the apparatus was removed. She had an old ulcer in her leg, which the peculiar construction of the splint admitted of being dressed daily without inconvenience. She was allowed to move the limb about in bed, and at the end of a week was permitted to rise for a short time. Considerable œdema of the leg took place, the wound became irritable, and erysipelatous inflammation spread up the limb, and eventually carried her off: she died exactly thirteen weeks from the receipt of the accident. On examination, two fractures were found; an oblique one extending through the greater part of the

trochanter major, which was split into two portions, and reaching to the trochanter minor: the other a transverse fracture within the articulation. Both of these had very firmly united, as it was believed by bone; but as much discussion arose out of the case, it was submitted to the test of boiling, when the union became loosened; prior to which, no force that was applied could move one portion from the other. The obliquity of the neck was lost in this case, and the limb shortened about three quarters of an inch. Had the patient lived for some time longer, there is every reason to believe that the union would have been still more consolidated.

A very interesting case of bony union and osseous deposit within the articulation is recorded by Christopher Henry Erndleus*. The following is the description which he gives of the nature of the accident:—“*Collum vel cervicem ossis femoris a violentiâ externâ frangi frequentius accidit, quam a plerisque creditur; ossea*

* *Relatio Itineris Anglic. et Batav. p. 86*

autem vel vitrea (uti à quibusdam appellatur) lamella in hâc parte tenuissima est, et quamvis communis sit opinio, ubi patientes de dolore et motu abolito in his partibus conqueruntur, exarticulationem vel luxationem ossis ischii accidisse, falsa tamen, imo propter incredibilem ligamentorum ac tendinum circumjacentium crassitiem ac robur, impossibile exarticulationem tali modo luxari. Talem fracturam his meis oculis vidi et manibus palpavi in cadavere fœminæ nosocomei muliebris Amstelodamensis sociæ in quâ tractu temporis, fractura illa cervicis ossis femoris dextri per callum coaluerit iterum, fœmina tamen exinde per omnem ætatem ad mortem usque clauda. *Callus pollicis latitudine sub ipso capite magno ossis femoris extabat, nulla autem in ligamentis ac tendinibus musculorum læsio vel præter naturalis constitutio erat."*

In this relation the author runs rather into the extreme, in supposing that a dislocation cannot take place, and he accounts for it on a wrong principle. But he proves, in a most decided way, and in language which will not admit of a doubt, that osseous

union can take place within the articulation without the ligaments being torn, or in the slightest degree injured.

This case is the more valuable, as a simple narrative of the fact, without any controversial speculation on the possibility or not of union within the joint.

In Mr. Heaviside's valuable museum, which he allowed me to examine with his usual liberality, there is a bone, evidently bearing the marks of having been obliquely fractured just at the insertion of the capsular ligament, in which there is a large osseous deposit round the base of the head, evincing strong ossific power in that part. Nothing is known of the history of the case. The neck has so completely lost its obliquity as to bring the head and top of the trochanter on the same level.

I have reserved to the last the highly interesting specimens in the possession of Mr. Abernethy, which were found by Mr. Stanley in the body of a subject in the dissecting-room. As it is Mr. Stanley's intention to publish a description of these bones, I will only so far anticipate that gentleman's account by stating, that they were both

found in the same subject; that the fracture on the right side was entirely within the articulation, and on the left side partially; that there was very little shortening of the limbs, arising only from the loss of obliquity in the neck; and, lastly, that the most perfect osseous union has taken place, which can be traced through the whole substance of the neck, in the different sections which Mr. Stanley has made.

This case must, I think, be admitted by the most sceptical, and must at once place the possibility of such an occurrence on the firm basis of actual demonstration. Nothing is known respecting the case, either as to the mode of treatment, or whether both the bones were fractured at the same time.

If it were allowable to hazard an opinion on the subject, I should feel disposed to attribute the accident to a perpendicular fall, which may have broken both necks at the same time: and I think it is highly probable that the firm and perfect union which has taken place may be referrible to the total inability to move either the pelvis or extremities, which must have been the necessary consequence of such an accident; for

it is hardly possible to conceive a more totally helpless state than that to which a person under such circumstances would be reduced.

Whether this opinion be correct or not, the fact of bony union cannot be controverted; and one single fact of the possibility of such an occurrence is sufficient; for

“ The first great cause
Acts not by partial, but by general laws; ”

and we may hence conclude, that bony union is possible under more favourable circumstances than have usually occurred.

Treatment.

THE mode of treatment in the fracture of the neck of the femur, whether within or external to the capsule, is the same as in any other fracture; namely, to reduce the limb to its proper length, to adapt the broken surfaces together, and to maintain them permanently in their situation. But the difficulty of accomplishing this is far greater, and cannot be obtained by the common line of treatment applicable to other cases. When the centre of a long bone is broken, the two ends may be closely adapted to each other; splints may be placed round the limb, and the whole kept perfectly steady. But, when the neck of the femur is the injured part, it happens that the shaft and head of the bone are nearly at right angles with each other. No lateral pressure, therefore, can have any effect in restraining the motion of the broken bones; and even supposing that it could, it is not possible to place any splint sufficiently high on the inside of the limb to have any direct control over the fracture. This is one great source of difficulty; an-

other, equally perplexing, arises from the close and intimate connexion that exists between the head of the bone and the pelvis, which causes the upper portion of the fracture to partake of every motion of the trunk : the consequence of which must be the continual disturbance of the broken bones ; and it is hardly necessary to add, that coaptation and permanent rest are indispensably necessary for perfect union. In treating these cases, it is essential to consider them as if the fracture existed between the pelvis and thigh ; and so to connect the two that they become like one body, and move together. The other indications are to keep up moderate permanent extension, and to take care that the limb is in every respect in its proper relative situation, not only as to length but direction.

An infinite variety of instruments and bandages have been at different times proposed, and have all had their advocates ; but either from their inefficiency, complexity, or the mischief they have caused, they have been laid aside.

I shall not impose on the patience of my reader by detailing them, but proceed at once to consider the modes of treatment in

most common use at the present day, and conclude with a relation of the improvements suggested by my own experience.

There are three different positions in which fractures occurring in any part of the thigh may be placed. First, the patient may be laid on the affected side, with the anterior superior spines of the ilium perpendicular to the horizon, with the thigh drawn up to an obtuse angle with the pelvis, and the leg bent to a right angle with the thigh. The great advocate, if not, indeed, the original proposer of this posture, was Mr. Pott, who may be said to have worked a complete revolution in this department of surgery.

The great advantage said to be obtained by this method, is the relaxation of all the muscles, and this is said to be effected by bending the limbs. Much stress is laid on the good resulting from this practice in fractures of the thigh; which, to use his own expression, “so often lame the patient and disgrace the surgeon.” The common acceptation of the term relaxation of a muscle, is the approximation of its two extremities; not by any contractile power of its own, but by position or some foreign assistance. The possi-

bility of effecting this with all the muscles of a limb, which ^{is} calculated to move in different directions, it is obvious must be visionary. But, although all the muscles which move the thigh cannot be relaxed, the advocates for this position maintain that the most powerful muscles can be so. Perhaps it would be more correct to say, that those muscles, whose attachments are most remote, and which consequently are most likely to exert a deleterious influence over the fracture, and which are most disposed to spasmodic contraction, are more relaxed in this position.

I must confess that it has ever appeared to me that too much stress has been laid upon this action of muscles; and I cannot but think that, if they were the sole agents in displacing a fracture, it would be very immaterial in what position a limb was placed. To me it appears that the displacement of a fractured thigh depends, in the first instance, on the direction and continued operation of the force which causes the breach of continuity; or on the superincumbent weight of the trunk and pelvis; or on the injudicious mode in which a

patient is removed after the receipt of an accident; or on some subsequent exertion, in attempting to use the limb or alter the position from that in which he fell. The muscles are but secondary agents: the broken spicula of bone, by lacerating them, render them irritable; they act spasmodically, and are no longer under the control of the will. When thus excited, they forcibly retain the bone in its wrong situation, and by their action considerably add to the deformity.

This action of muscles is easily overcome by soothing and quieting the agitation into which they are thrown, by gently and gradually extending the limb, and restoring the broken bone as accurately as possible to its proper situation. By these means the muscles, in a longer or shorter time, in proportion to the injury they have sustained, will lose the disposition to retract the limb; and, provided they receive no fresh irritation from any further displacement of the fracture, this will seldom exceed twenty-four or forty-eight hours.

If these premises be correct, we must look for other advantages to induce us to

give a preference to the side position. Those who advocate it state that the whole limb is equally supported, and that, in fractures of the neck, the broken surfaces are kept closer in contact. I do not mean to deny that cases may have done well in this position; but I must state, that I have never seen a case so treated unattended with considerable lameness, and eversion of the foot. The objections to this plan are, I think, manifold. In the first place the great difficulty, I will add almost impossibility, on a common hospital bed, of retaining a patient permanently on the side, is a very serious objection; and the slightest deviation from it causes the pelvis to gravitate, and turn more or less supine; carrying with it the upper portion of bone: the effect of this must be a permanent eversion of the leg and foot. But I will suppose that great care has been taken in preparing the bed, and every precaution used to keep the patient with the pelvis in the position above described; still, in fractures of the neck, or at the root of the trochanter, the whole weight of the pelvis resting upon the broken part, and bruised integuments, causes the

most insufferable pain, and in old emaciated persons would soon produce gangrene; and should the broken surfaces not exactly correspond, all these evils would be increased tenfold.

Added to these fully sufficient objections, I might urge the irksomeness of the position, which cannot be in the least degree varied; the nearly entire loss of the use of the arm on the affected side, the want of any power to counteract the retraction of the limb, and the great difficulty of comparing the limbs together, to ascertain whether the affected one be of its proper length. Most of the above objections apply equally to fractures in any part of the thigh, but with particular force to fractures at the upper part.

The next position in which fractures of the thigh-bone, or its neck, may be placed, which I shall now proceed to consider, is the straight or extended position, which is usually employed on the continent, and by many practitioners in this country. The patient is placed on his back, and the limb is kept permanently extended by means of a long splint, reaching from above the ilium to below the foot. The extension is main-

tained by the foot being bound firmly to the lower extremity of the splint, whilst bands pass from the upper part across the groin, and round the inner side of the thigh. Bands are also passed round the pelvis, connecting it with the upper part of the splint. This is the principle on which many different apparatuses have been constructed; that of Desault's consists of the simple long splint, to which the limb is bound by a multitude of bandages. Boyer has improved on this, and added a moveable foot board, which can be extended by a screw.

The object of all these machines is the same: to connect the thigh firmly with the pelvis, and keep up permanent extension of the broken limb. I have either tried all these, or witnessed their application; and although, with great care and attention, I have no doubt that they may answer the proposed purposes, yet they all are liable to many and serious objections.

In the first place, the perfectly supine position which is required to restrain the tendency of the body and pelvis to sink to the lower part of the bed, is irksome and unfavourable to the taking food, and still

more so to the expulsion of the fæces and urine. In several cases I have known the employment of the catheter necessary both in the male and female; and very painful retention of urine, with all its distressing attendants, has been the consequence of neglect.

In removing the fæces, more or less motion must be given to the pelvis; and as the other limb is left at liberty, there will, in all cases, be more or less power of moving the pelvis as the bandages become loosened; and consequently the upper portion of the fracture will be liable to be displaced, which cannot but be unfavourable to bony union.

The prodigious number of bandages in Desault's apparatus is productive of great trouble and inconvenience. The pressure which, in all the modifications of the long splint, is made across the groin causes great œdema of the whole limb, in consequence of the obstruction which is afforded to the circulation in the inguinal veins and absorbents. The bandages at the upper and inner part of the thigh are so liable to become soiled and wetted, particularly in

the female, that distressing excoriation and ulceration, succeeded by enlargement of the glands, are by no means unfrequent consequences. But all these objections, by great care and assiduity on the part of the surgeon, may be counteracted, and in some measure obviated. There are, however, other objections, which have not hitherto met with the attention they merit, but which, I am confident, have, in many instances, contributed to retard the recovery, and produce permanent deformity, not only in fractures of the neck, but likewise of the shaft of the bone.

In the application of the long splint, the two principal points of bearing are at the foot, and at the tuberosity and ramus of the ischium. Between these two parts the limb may be extended; and, by comparison with the other limb, the length of the two may appear exactly equal, and the surgeon may flatter himself that the broken bones are in perfect coaptation; but there is another very important circumstance to attend to, namely, the direction of the bone. This has been already pointed out in the anatomical description, where the great obliquity of the

shaft of the bone, particularly in the female, has been dwelt upon.

In Desault's apparatus, and, indeed, in all the applications of the long splint, the limb is bound to a perfectly straight body, which is placed at the outside of the thigh, and considerable pressure is made on the inner side of the knee; which, in fractures of the shaft of the bone, tends to destroy the natural obliquity of that part, and bring it more into a straight line, which is not only destructive to the symmetry of the limbs, but impedes progression, and renders the erect posture less secure.

In fractures of the neck of the bone, pressure applied in the same direction will separate the lower edges of the fracture, and thus materially increase the difficulty of union. The forcible pressure from within outwards, which is made at the point of extension at the upper and inner part of the thigh, will often separate the broken portions of bone. The straight position is also objectionable, with reference to the arched form of the thigh; for I conceive it must be self-evident, if we take an arched and oblique body, in which there exists any breach of

continuity, and attempt to forcibly confine it to a straight unyielding plane, that more or less displacement in the proper relative situation of the different parts must be the consequence. It is true, that, by the employment of graduated pads, the natural direction of the thigh-bone may be preserved; but this precaution is nowhere inculcated, and I have never seen it attended to.

Of all the instruments for maintaining the thigh in the straight or permanently extended position, perhaps the one proposed by Mr. Hagedorn is the most simple, and the least liable to objection. A description of this instrument is given in the last edition of Mr. S. Cooper's *First Lines of Surgery*, page 430. The superiority of this apparatus, I conceive, consists in the restraint imposed on both limbs, by which the correct length of the affected limb is more accurately ascertained, and the motions of the pelvis more restrained; and further, all pressure across the groin and inside of the thigh is obviated, by making the sound limb the means of extending the affected one. If there was superadded any simple and convenient mode of removing the fæces without

in any degree moving the pelvis, I should not hesitate to pronounce Hagedorn's apparatus as perfectly adapted to fulfil all the ends proposed. It must, however, be considered as defective in this respect; and, moreover, there does not appear to be any effectual resistance to the descent of the pelvis on the affected side, which would, of course, produce more or less shortening of the limb. As I have never witnessed the application of this instrument, any remarks on its superiority or defects can only be conjectural.

Before concluding my observations on the straight or extended position, it will be right to mention one case, in which every straight splint, even that proposed by Hagedorn, would be perfectly unavailing,—namely, when the fracture is just below the trochanter minor; in which case the psoas magnus and iliacus internus muscles often draw up the upper portion so forcibly towards the groin, as to cause a very evident projection at that part; and if the bone should unite in this position, the most distressing lameness and deformity must be the inevitable consequence.

In this case, which forms an exception to the general rule of the lower portion of the fracture causing the deformity, it is necessary to bend the thigh very much on the pelvis, almost to a sitting posture, to facilitate the approximation of the broken ends of the bone. Any attempt to employ the extended position under any modification would be nearly certain of failure, unless the spasmodic action of the psoas and iliacus could be effectually overcome and the bone replaced in its situation; which would be very difficult to accomplish, in consequence of the shortness of the lever and the want of antagonist muscles. This case, however, is certainly of rare occurrence, and the treatment of it is attended with peculiar difficulties.

The next plan of treating fractures of the thigh which I shall consider, is the one recommended by Sir A. Cooper in fractures of the shaft of the bone, and in fractures of the neck external to the capsule. This consists of a double inclined plane, which was first suggested by Mr. White of Manchester, and subsequently improved on by Mr. James of Hoddesdon. In the simple form of in-

clined plane described by Sir Astley, there is no plan for confining the foot, and preventing it from turning outwards; the motions of the pelvis are likewise not at all restrained, and the other limb being left perfectly at liberty, will greatly facilitate such motions, which, indeed, are rendered absolutely necessary, to enable the patient to obey the dictates of nature. The principle of the double inclined plane is excellent, and, with certain modifications and additions, it will probably be found the most eligible mode of treating all fractures of the thigh; but the one depicted in Sir Astley's work is certainly very inadequate to fulfil the various objects which are required.

In conclusion, I shall now proceed to state the result of my own labours in this department, and candidly avow the difficulties I have met with, and the attempts I have made to overcome them.

At a very early period of my professional career, I was fortunate enough to have the superintendence of a very complicated case of fracture of both thighs and one arm in the same individual. I say fortunate enough, because the exertions I was then obliged to

make, and the reflections which I then made, laid the foundation for the success which has subsequently attended my practice, and for the improvements which I have now to offer to the profession.

The accident occurred in the year 1806; the patient was treated with the long splints, and the limbs extended. It is hardly possible to conceive a more helpless state than this poor fellow, who was half an idiot, was reduced to; in a very short time, from the impossibility of keeping him clean, he became excoriated, and maggots formed under him, which induced him to move the pelvis, and daily to displace the fractures. The necessity for some contrivance to facilitate the operations of nature was imperiously called for; and at the spur of the moment I constructed a double bed, an account of which was published by my late father, in a letter, containing observations on fractures of the lower limbs, &c. This contrivance was deemed worthy of an honorary reward from the Society of Arts and Sciences*.

By this contrivance I gained one object,

* See Transactions of the Society for the Encouragement of Arts, &c., vol. xxix., p. 118, for the year 1811.

which appeared to me of much consequence, as the want of it was daily manifested in hospital practice, in all bad injuries to the lower extremities and pelvis. I obtained a state of permanent rest for the whole trunk and extremities, and afforded the patient the additional comfort of cleanliness. It is true that this apparatus was by no means so perfect as it might have been, and as I have since rendered it; but the principle was a correct one, and aimed at once at the removal of one of the greatest difficulties which surgeons in all ages have had to contend with, and which Sir Astley even now acknowledges to be *the greatest obstacle* in the treatment of fractures within the articulation.

Not long after the construction of this double bed, I had an opportunity of employing it in a case of fracture of the cervix femoris. With a view to obviate some of the inconveniences which I had observed in the employment of Desault's and Boyer's splints, the following apparatus suggested itself to me, which I employed in this case in conjunction with the double bed.

I obtained a long splint, which reached from above the ilium to the foot; at the

upper part of which there was an iron rack with teeth and a spring, which rack could be elevated or depressed to the extent of some inches at pleasure. At the top of this rack there was a cross bar, with two buckles attached to it. At the bottom of the splint there was an iron plate, shaped like the foot, which stood out at some distance from the splint, to allow for the obliquity of the thigh-bone. This foot-iron projected considerably at the heel, to prevent any continued pressure on the integuments covering the os calcis. The rest of this apparatus consisted of a shorter splint for the inside of the thigh, which did not extend below the knee. At the upper part of this inner splint there was another moveable rack, which terminated in a crutch, which was exactly adapted to press on the tuberosity of the ischium and ramus of the pubes, and which was well padded and covered with leather. At the lower part of the inner splint there were two strong studs, to which two broad leather straps were attached, one of which passed obliquely across the front of the thigh nearly in the direction of the sartorius muscle, and the other obliquely behind the thigh, and both were fixed to the

buckles at the top of the outer splint. When this machine was used, the foot was first padded and secured to the foot-board. A proper compress was placed on the tuberosity of the ischium, and retained there by the pressure of the crutch, which was nicely fitted to the part. The two splints being applied, and a firm compress laid on above the trochanter, the straps which proceeded from the lower part of the inner to the upper part of the outer splint were tightened by elevating the rack, and thus the limb was permanently extended between two fixed points; the foot below, and the ischium above. Several objects were gained by this modification; all pressure across the inguinal region was avoided, by removing the lever of extension to the lower part of the thigh; and even the pressure of the strap obliquely across the thigh was lessened and diffused by the interposition of a small padded splint in front and behind. The crutch at the top of the inner splint could be raised and depressed to change the soiled or moistened compress daily, without at all disturbing the rest of the apparatus or moving the limb, which, in several cases, prevented

serious excoriation. The degree of extension was easily regulated by means of the rack at the top of the outer splint. The line in which the extension was made, by acting on the compress at the upper and outer part of the thigh, tended to approximate the broken surfaces of the bone, at the same time that the limb was maintained at its proper length.

The obliquity of the thigh was preserved by the foot-iron standing out from the splint; and further, by the knee being attached to the inner instead of the outer splint. Lastly, the whole limb was left free from any undue pressure and restraint, and could be hourly compared with the opposite limb.

With this apparatus I treated successfully several cases of fracture of the shaft and neck of the thigh, sometimes with the addition of the double bed, and at other times without it, accordingly as circumstances permitted. One day, however, I was foiled in attempting to adapt it to a very lusty woman, whose thigh was so full at the inner part as to prevent me from applying the crutch of the inner splint to the tuberosity

of the ischium. The case was an interesting one of fracture of the neck, from a slight fall in getting into bed. The patient, a young woman, was, at the time of the accident, in the hospital for a periodical bleeding at the nipples, and her health was much deranged. To meet the difficulties attending her case, I constructed the following apparatus, consisting of a broad belt of calf-skin, lined and padded with wash-leather, which was passed round the pelvis just below the cristæ of the ilia, and buckled in front, nearly opposite the sacro-iliac symphysis; on each side two strong straps were fixed to the upper edge of the belt, which passed up beneath the patient's back and pillow, and were attached to the head of the bed. Two more well covered straps were attached to the lower edges of the belt nearly opposite to the former, and these were brought round from behind the buttocks on the inside of the thighs, and fixed to strong buckles on the anterior part of the belt. By these means the descent of the pelvis was effectually prevented; for, even supposing that the bed and the patient had been placed perpendicular, the body and pelvis would have re-

mained suspended. The patient was placed on a double bed; and this, combined with the belt, rendered all motion of the pelvis unnecessary. The extension of the limb was easily accomplished by a moveable foot-board, to which the foot and ankle were bound, and thus eversion was prevented. Extension was made with a weight and pulley attached to the foot-board. This mode of treatment I found very simple and efficacious, and productive of very little inconvenience or trouble to the patient, who recovered perfectly and without deformity.

I employed this belt and double bed with the weight and pulley in several other cases, and should probably have continued to use it at the present time, but that a more simple and more comfortable method of treatment suggested itself, which was equally applicable to all cases of fracture of the thigh and pelvis, and not subject to any of the objections to which the other modes of treatment were liable. For the two modifications of treatment by permanent extension on the double bed, with the improved long splint or the pelvic bandage, were still productive of occasional trouble and inconvenience, arising

from the irksomeness of the horizontal posture, and the sinking of the nates through the aperture in the upper frame. The iron uprights, also, which moved the upper frame of the bed, were liable to get out of order, and communicated a jarring motion to the patient when worked; added to which objections, the bed was too expensive for general use.

More extended practice in these cases convinced me, that the most desirable objects to be attained were an *easy comfortable position, which could be endured for a considerable length of time*, even by persons advanced in years and emaciated; some contrivance to facilitate the operations of nature, and admit of strict attention to cleanliness, without allowing the slightest movement of the pelvis; and lastly, a plan for maintaining the limb in its proper situation, more by position than any forcible counter-extension, which, in very old persons, is often productive of more injury than good. The plan which I now have the honour to submit to the profession, will, I believe, be found to fulfil all these indications. It is at once simple and easy of application;—it can be

endured for an indefinite length of time, which is very essential in treating fractures within the articulation, which require several months for perfect union;—it is fully adequate to maintain the pelvis quiet, and to extend the limb;—and lastly, the expense of it is very trifling. Pretty ample experience for two years and a half has only tended to confirm me in its great utility, and has enabled me to speak with confidence of its efficiency, not only from my own practice, but that of many professional friends. It will be found to combine all the advantages of the bent and straight position, without being subject to any of their objections; it unites the ease of the relaxed state of the more powerful flexor muscles, with the security of permanent extension, and, at the same time, affords the most comfortable position for the head and trunk, allowing the greatest facility for ingestion and dejection, and leaving both arms perfectly at liberty.

The apparatus* consists of a modification

* This apparatus was rewarded by the Society of Arts, &c. with their large gold medal, and is described in vol. xxxix. of their Transactions.

and improvement of the double inclined plane. The bed on which the patient is placed is divided into three portions, the upper one for the trunk, the short middle one for the thighs, and the lower division for the legs. These admit of being placed at various angles and in different positions, as will be best seen by a reference to the plate. The following are the advantages gained by this apparatus:—When the patient is placed on the bed, the pelvis will, from its own gravity, remain fixed at the bottom of the angle formed by the superior and central inclined planes; and the aperture made in the central part readily admits of the patient relieving himself, and being properly cleansed, without the least movement of either trunk or extremities. Should it be desirable, in young persons, or under particular circumstances, to secure the pelvis more firmly, it may be easily accomplished by two broad straps, brought from the edge of the aperture, and passed obliquely round the upper and outer part of the thighs; which should pass once round the pelvis, and be attached to buckles at the outer side of the mattress. By this simple plan the

possibility of motion of the pelvis is prevented, and firm compression may be applied over the trochanter : this will, however, very rarely be required, as, generally speaking, the weight of the pelvis is sufficient to keep it steady ; and no other bandage is requisite than that which secures the feet to the foot-boards. The position of the patient, namely, on the back, on a gently-inclined plane, with the thighs and legs half bent, and the whole equally and firmly supported on a level surface, is one peculiarly easy and comfortable, and can be longest endured without complaint. The knee being bent over a double inclined plane, affords the best and easiest means of making permanent extension, by placing the fulcrum under the ham, and making a lever of the leg, whilst the foot is securely fixed to the foot-board, and all eversion or inversion prevented. The gradual curve, formed by the mattress on the double inclined plane, is exactly adapted to the naturally arched form of the thigh-bone, and is the least likely to cause any derangement in the length and direction of the broken limb. The central division of the bed admitting of being drawn out

to the extent of several inches, enables the surgeon to adapt it to the exact length of the thighs of different individuals. The juxtaposition of the limbs affords constant opportunity of minutely comparing them, and of observing whether they exactly correspond. The apparatus for fixing the feet at the same time supports the bed clothes, takes off pressure from the heels, and maintains the limb at its proper length. By fixing both feet to the foot-boards, all motion of the pelvis and lower extremities is more effectually prevented; for, when the sound limb is left at liberty, the patient is very apt to move it, and to shift his position from the central aperture.

Although this apparatus was, in the first instance, constructed expressly for fractures within the articulation of the hip, I have since adapted it to other injuries and diseases, in which a state of permanent rest is essential to perfect recovery. It has been employed, with the happiest result, in many cases of active disease of the spine and hip; and in compound fractures of the thigh and leg, it has been the means, in several instances, of preserving limbs and lives.

For the additional comfort of such persons as are capable of mental recreation, I have added a swing table and reading desk, which will support a book over the patient's head, without any effort on his part. Although the apparatus now under consideration is very simple in its construction, I am well aware that it is liable to be sometimes ill adapted, and may be misunderstood by persons not possessing any mechanical turn: with a view to obviate, as much as possible, such an occurrence, I shall subjoin full directions to be observed in employing it; a want of attention to which has, in some rare instances, led to a supposed failure in attaining the ends proposed.

Directions for using the double inclined Bed.

DURING long confinements to bed, particularly when it is necessary to preserve the same position for weeks, and even months together, which is absolutely requisite to obtain perfect bony union in fractures of the cervix femoris, it is of essential importance to the comfort of the patient, and often to the success of the practitioner, that great attention should be paid to render the bed as permanently level and smooth as possible. This is of so much importance as to merit the serious attention of the surgeon, who ought never to place a patient, under such circumstances, on any bed, until he has himself examined it. To some gentlemen this may possibly appear unnecessary ; but I can practically assure them, that this little preliminary trouble will very often save them much subsequent anxiety and vexation, and mainly contribute to the happiness and comfort of their patients. In constructing this apparatus I have bestowed considerable pains in endeavouring to alleviate the sufferings of persons labouring under complicated

accidents and diseases: in doing so, however, I have by no means exempted the surgeon from that part of his duty which I have above alluded to; and in the employment of this bed I would particularly invite his attention to the following directions. The mattress should be either of horse-hair, or well stuffed with the best wool, and should be nailed round its edge, at the upper division of the frame. A blanket and sheet should be separately strained over the mattress, and carefully sewed all round its edges: this will prevent any subsequent wrinkling, and by sewing first the blanket, and then the sheet, it is obvious that the latter may, if necessary, be detached, without at all disturbing the former. The whole apparatus is made narrow, both to facilitate the operations of the surgeon and nurse, in dressing or cleansing the patient, and to prevent him from shifting from the central aperture. Half a blanket, and a single breadth of sheeting, will, in all cases, be sufficient; and in fitting them to the central aperture, it is better to make a cross cut from the four corners, thus \times , than to remove any part.

The loose edges should then be turned down, and sewed at the lower part of the opening. By this plan any hardness of the edges of the aperture will be avoided. In fractures of the thigh, the length of the healthy limb should be accurately taken, and the central division of the bed should be drawn out, so as to make a slight degree of extension at the ham, when the limb is placed over the double inclined plane. The foot-board should likewise be placed at the proper distance to meet the feet. The patient may now be placed upon the bed, and the fundament should be exactly opposed to the central opening. In fractures through the cervix the pelvic bandage may be employed, but, generally speaking, the weight of the pelvis at the bottom of the inclined planes is sufficient to keep it steady; and the patient soon finds himself so easy and comfortable that he is very unwilling to move. Both feet should be secured to the foot-boards, either by bandages, or a pair of short cloth boots, made to lace in front, quite down to the toes. This plan will be found more comfortable than any common bandage, and the boot can be secured to

the foot-board by screws or straps. In cases where retraction has taken place, the powerful extension obtained by placing the fulcrum under the ham, and securing the feet, will very soon reduce the limb to its proper length, and maintain it steadily in that position. In the cases in which I have employed it, I have not found it necessary to use any splints, even in fractures of the shaft of the bone; but, if requisite, they may be added. In compound fractures of the thigh or leg, where there is a probability of profuse discharge, it will be better to add some oil silk, and a draw-sheet under the part affected. When the fracture occurs immediately below the trochanter minor, and there is much spasmodic contraction of the psoas and iliacus muscles, it will be right to raise the superior and middle divisions of the bed very considerably, so as to place the thigh nearly at right angles with the body: this will completely approximate the fractured surfaces, which is with great difficulty accomplished by any other mode of treatment. As the extension in fractures occurring in any part of the thigh-bone is effected by the pressure on the calf of the leg; and in the

ham, it is particularly necessary to adapt the central division of the bed to the exact length of the limb: when necessary to make any trifling alteration in this degree of extension, this is best effected by placing wedges of wood beneath that part of the mattress which supports the calf of the leg. The mattress being left loose at this part, readily admits of this being done without disturbing the patient.

Description of the Bed for Fractures, &c.

THE apparatus consists of a strong frame, A, which is rabbeted, as shown at B, figs. 1 and 2, to receive a moveable frame of the same length, but about three inches narrower. The moveable frame is divided into three parts, connected by joints; the superior one, C, is the longer, and is intended to support the head and trunk. The middle division, D, which is the shortest, is adapted to the thighs, and is capable of being lengthened or shortened, to the extent of several inches, to adapt it to limbs of different length, as seen at U, V, and W, fig. 6. The inferior division, E, is intended to support the legs. This latter part is divided up the middle, for the convenience of varying the position of either leg, as shown in fig. 2. The moveable frame is connected with the fixed one, by means of the iron pivots, F, which turn in the sockets which are screwed to the outer frame, at the junction of the upper and middle divisions. Different degrees of elevation may be given to the dif-

ferent divisions by the props, G, H, and I. The props, G and H, work in racks, at the bottom of the rabbet B. The props, I I, are fixed to the upper frame by hinges, formed with a staple and ring. They are notched at one side, at given distances, and can be dropped upon the screws. Fig. 7, No. 2. By the assistance of these props, the inferior divisions may be placed at different degrees of elevation, as seen in fig. 1, 2, and 4. The whole of the upper, or moveable frame, is boarded over, and should be bored through with numerous holes, to admit air, and prevent the perspiration from rotting the bedding. A well stuffed hair or wool mattress, K, is fitted to this, which is nailed to the upper and middle divisions, but left free at the lower division, to enable the apparatus to be adapted to limbs of different length. The central division has a long narrow trap-door, L, about three inches and a half wide, and a foot long, which can be let down for the admission of the proper utensils, figs. 9 and 10, for the removal of the fæces and urine. This opening is made narrow, to prevent the pelvis from sinking into it. The mattress at this part has a cor-

responding vacancy, which is filled up, when not used, by a pad adapted to the opening.

A similar trap-door and moveable pad may be made in the superior division at M, for the convenience of dressing issues and setons, in cases of diseased vertebræ, where the slightest motion of the body should be avoided. The situation of this latter opening, and its length, must vary according to the part affected in the individual to whose case it is adapted ; but it should not exceed six inches in width, for fear of taking off too much of the support of the trunk.

The rest of the apparatus consists of two pieces of wood, N, shaped like the soles of the feet, through which an iron rod, O, passes, which is affixed by two thumb-screws to two uprights, P, which rest, by a broad base, on the edge of the inferior division, and are confined in their situation by screws, which fit into the iron plates, Q, which have several holes at the interval of one inch, to adapt the lower division to legs of different length. To these foot-boards the feet are firmly fixed in fractures of the lower extremities ; and, in most cases, this will

supersede the use of splints. A swing table and reading-desk, R, S, T, have been added, for the additional comfort of patients. On each side of the fixed outer frame there are iron sockets, as seen at Y, figs. 4 and 6, which receive two uprights, which support a shelf or table, X. This can be raised to different elevations, and retained by pins passing through the uprights into the iron sockets. This will be found a valuable addition in cases of complicated injury to the upper and lower extremities; and will form a convenient table for patients in hospital practice, where the reading desk is not wanted.

Fig. 1 shows the apparatus complete, with the lower division in the proper position for fractures of the leg.

Fig. 2 gives another view of the apparatus; the trap-door for the spine is left open, and the two portions of the inferior division are placed at different angles. That on the right side is the position for fractures of the patella; that on the left for fractures of the thigh.

Fig. 3 shows the apparatus, with the

planes let down ; which in that state may be employed as a common bed.

Fig. 4 gives a side view of the apparatus in the proper position for fractures of the leg, with the addition of the moveable shelf or table. Fractures of the pelvis, or diseases of the hip or spine, may be placed either in this position or the one shown at fig. 5, which is the proper one for fractures of the thigh.

Fig. 6 exhibits the upper surface of the frame without the mattress, and shows the mode by which the central division may be lengthened or shortened.

Fig. 7. The under surface of the same, giving a complete view of the mechanism by which it is worked.

Fig. 8 shows the mechanism of the upright which supports the foot-board.

Fig. 9. The utensil adapted to the size and angle of the central opening.

Fig. 10. Urinal for men ; particularly useful in cases of paralysis of the bladder, accompanied with incontinence of urine.

Perhaps it may be thought that I have been tediously explicit in describing the

various parts of this apparatus. I have been induced to be thus minute, to enable any person who may reside at a distance from London to construct these beds, which are so simple in their mechanism that any common carpenter may make them. I am well aware that the different motions might have been improved ; as, for instance, the different divisions might have been worked by ratched quadrants ; but this would have rendered them far more expensive, and would not have materially added to the comforts at present obtained. In constructing any apparatus which is intended to be extensively useful, simplicity and economy must be the two leading principles.

OBSERVATIONS

ON

FRACTURES OF THE OLECRANON:

WITH CRITICAL REMARKS

ON

THE DIAGNOSIS OF THAT ACCIDENT.

OBSERVATIONS

ON

FRACTURES OF THE OLECRANON.

FEW accidents occur in the practice of surgery, in which the reputation of the practitioner and the welfare of the patient are more at stake, than in the various injuries which occur in the immediate vicinity of important joints, and to the joints themselves, especially those of the upper extremity. As the perfect and free action of these parts is essential to the due performance of their functions ; and consequently to the comfort, and often to the means of subsistence of the individual, it follows, that any error of judgment in the surgeon may be productive of most serious and permanent injury. Strongly impressed with the truth of the above position, and of the importance of giving publicity to all new facts relating to such injuries, I am induced to

offer the following narrative of a fractured olecranon, and the accompanying remarks, to my professional brethren; which may serve as an useful caution to them not to pronounce too hastily on the nature of an accident, in consequence of the absence of some of the usual diagnostic marks; and, at the same time, it may supply an important link in the history of these cases.

In the summer of the year 1820 Mr. L. W. was thrown from a high tandem, with great force, and struck his head and left elbow against a brick wall. He soon recovered from the shock; and his great anxiety for a young friend, who had been dragged for some distance, and over whose body the wheel had passed, led him to disregard his own sufferings. The accident occurred some distance from London. They were both examined on the spot by a surgeon, and although no swelling at that time had occurred at the elbow, no fracture was detected. Mr. W., with his young friend, were removed to town in a post-chaise, and during the journey he frequently supported his companion, who was very faint, on the affected arm. I saw them both about four

hours after the accident, and could hardly persuade Mr. W. to allow me to examine his elbow, which, by this time, was greatly swollen, and extensive ecchymosis had taken place over the whole arm and forearm. Although any attempt to move the arm was productive of pain, yet I clearly ascertained that pronation, supination, flexion, and extension, could be perfectly and spontaneously performed. Twenty leeches were applied to the elbow, and the bleeding encouraged by a warm poultice through the night. The following morning the swelling was much abated. On the 3d day he was sufficiently recovered to be able to attend at his house of business; where he used his arm with great freedom, and occasionally leant upon the elbow in the act of writing. This created some uneasiness, and a weary heavy pain in the joint. On the 6th morning, in attempting to put on his neckcloth, which required the forearm to be in a state of extreme flexion, he felt a sudden increase of pain, which continued for some time; and on attempting to extend the arm, he could not accomplish it beyond the point to which the mere gravity of the forearm and hand

carried it. Up to this period both *flexion* and *extension* of the elbow-joint could be perfectly performed. On examining the arm, I now most distinctly ascertained that the olecranon was fractured. On bending the forearm, a separation between the olecranon and the shaft of the ulna could be evidently traced. This separation, however, was only in consequence of the removal of the lower portion in the act of flexion; the upper portion remained exactly in its proper relative situation, and there was not the slightest disposition in the triceps to retract it.

I placed the limb, with the forearm slightly bent, to an angle of about 160 degrees, as nearly as possible in the position in which the arms remain in a state of repose. This allowed of the most perfect coaptation of the fractured surfaces, without any forcible compression of their posterior broken edges. Splints of thick wetted paste-board were adapted to the whole limb, which were strengthened with glue, and lined with wash-leather when dry. The case went on most favourably, and in six weeks he was enabled to use the arm freely; the motions of it were quite restored, and

the bone had firmly united, without any perceptible interval. The lateral motion of the detached portion was restrained by compresses and cross-straps of adhesive plaster. The only peculiarity attending this case, which has induced me to give it publicity, was the power of extending the elbow with force, up to the 6th day after the accident; the nature of which would, in all probability, have remained undetected, but for the forcible degree of flexion employed in passing the neckcloth round the neck. In this attempt the tendinous expansion which covers the olecranon was torn through; which, up to that time, had been a sufficient bond of union to allow of extension of the arm, and to hold the fractured portions together; between which there was a simple breach of continuity. It is probable that the leaning the weight of the body on the elbow, on the previous days, likewise contributed to effect the laceration of the aponeurosis.

The case, although an insulated fact, appears to be of consequence, as, on looking to many authors who have written upon

this subject, I do not find any similar occurrence recorded: yet in reflecting on the most common mode in which this accident occurs, namely, from the direct application of force to the olecranon, it appears to be by no means of improbable occurrence; as the direction of the force does not, in general, tend to cause any separation between the broken surfaces. The erroneous opinion which a surgeon, not aware of this circumstance, would be induced to form, might be very injurious to his reputation should the nature of the accident be detected by any other person; and to any one who strictly followed the rules and directions laid down in systematic writers, such a mistake would be very possible; for we find it invariably stated, that a loss of the power of spontaneously extending the forearm is the constant and immediate consequence of a fracture of the olecranon.

In the case above related I was certainly induced to give an opinion that no fracture existed, although the force and direction of the blow led me to suspect one. Fortunately the error was detected in time to enable me

to restore my patient to the perfect use of his arm: and he being a very candid and sensible man, was capable of fully understanding the nature of the accident, and the source of fallacy.

Another diagnostic mark of fracture of the olecranon, which is constantly insisted on by authors, is the degree of retraction of the superior portion, by the action of the triceps extensor cubiti.

In speaking of this accident, we find the following passages in Boyer's *Leçons sur les Maladies des Os*. — “ Quelle que soit la cause de la fracture, lorsque celle-ci est effectuée, le muscle triceps brachial entraîne en haut l'apophyse olécrâne détachée du cubitus; l'olécrâne monte plus ou moins haut derrière la partie inférieure de l'humérus. Mais elle s'élève toujours au-dessus de ses tubérosités inférieures, ou condyles, qu'elle ne surmonte point dans l'état naturel.”

“ On réduit en étendant fortement l'avant-bras sur le bras, et en repoussant vers le cubitus l'olécrâne qui tire en haut l'action continuelle du triceps brachial. C'est contre la contractibilité toujours agissante de ce

muscle qui tend sans cesse à entraîner l'olécrâne isolée, et l'éloigner du cubitus, que tous les efforts de l'art doivent être dirigés*."

In Desault's *Œuvres Chirurgicales*, par Bichat, we find the following description :—
 “ Il arrive ici ce que l'on observe constamment dans la fracture de la rotule. Le triceps extenseur n'ayant plus dans la continuité du cubitus une résistance à ses contractions, entraîne au haut le court fragment auquel il adhère.” The other diagnostic marks he mentions are, first, the one which has been alluded to in the former part of these observations. “ L'impossibilité du mouvement spontané d'extension de l'avant-bras sur le bras, résultat nécessaire de l'isolement du triceps d'avec le cubitus.”

“ 2°. La demi-flexion constante de l'avant-bras, effet des contractions du biceps et du brachial interne, auxquels ne s'oppose aucun antagoniste.

“ 3°. L'élévation plus ou moins sensible de l'olécrâne au-dessus des condyles qui sur-

* *Leçons du C. Boyer, par Richerand, pp. 166, 7.*

monte au contraire cette apophyse, lorsque, dans l'état naturel, l'avant-bras est demi-fléchi*."

Sir Astley Cooper's more recent work contains similar observations : — " This process of the ulna," he observes, " is not unfrequently broken off, and the accident is followed by symptoms, which render the injury so evident that the nature of the case can scarcely be mistaken. Pain is felt at the back of the elbow, and a soft swelling is soon produced there, through *which the surgeon's finger readily sinks into the joint of the elbow*; the olecranon can be felt in a detached piece, sometimes elevated to half an inch, and sometimes to two inches above the portion of the ulna, from which it has been broken. This elevated portion of bone moves readily from side to side, but is with great difficulty drawn downwards: if the arm be bent, the separation between the ulna and the olecranon becomes much greater. *The patient has scarcely any power to extend the limb, and the attempt produces considerable pain†,*" &c.

* Desault, par Bichat, tom. i. p. 166.

† Sir Astley Cooper on Fractures, &c. p. 485.

The high authorities which I have quoted above, would lead us to expect, in all cases of fracture, to meet with more or less retraction of the olecranon, with loss of power of extension; more especially as no exceptions are mentioned, nor the possibility of such even hinted at*. Any person expecting to meet with these unequivocal symptoms, will, I am convinced, be frequently led into error.

I have already mentioned one case in which no separation took place between the broken surfaces, and no displacement of the upper portion; and it has fallen to my lot to witness several cases in which there has not been the least retraction of the detached portion; and the separation between the

* Since the above was written, I find an exception to this in Delpech, *Précis Elémentaire des Maladies réputées Chirurgicales*, tom. i. p. 262. He says, " Si ce n'était l'expansion aponévrotique que le tendon du muscle triceps brachial étend sur la face postérieure de l'olécrâne, les fragmens de cette fracture seraient portés à des grandes distances en obéissant à l'action du muscle dont il s'agit, et à celle des fléchisseurs de l'avant-bras; mais le plus souvent cette expansion n'est plus rompue, du moins complètement, et ce qu'il en reste ne permet qu'un écartement borné des fragmens."

broken surfaces has been entirely referrible to the degree of flexion of the arm removing the lower portion of the ulna from the olecranon. I feel happy in having the testimony of the late Mr. Sheldon in support of this observation; and his authority, on this subject, carries with it additional weight, from the circumstance of his having suffered from this accident in his own person. In speaking of this injury he makes no mention of any retraction, but refers the separation between the fractured portions entirely to position. "The bending of the forearm removes the lower portion of the olecranon from the superior, and a space is left between the two fractured portions of bone*."

A little consideration of the nature of this accident will readily explain this circumstance. It is generally stated that the olecranon may be broken, either by the action of the triceps, or by the direct application of violence to the part affected. The former of these causes is extremely rare: it is, indeed, mentioned by most systematic writers, but rather, I should conceive, from

* Essay on Fractures of the Kneepan and Olecranon, p. 64.

the supposed resemblance between fractures of the olecranon and of the patella: in which latter case fracture from muscular action is by no means an uncommon occurrence, than from any actual observations which have come within the scope of their own experience.

On referring to many of these writers, I do not find a single recorded instance of such an occurrence, although many cases of fracture from falls and blows are detailed in Desault's Journal, in the Journal de Médecine, Camper, and other works. Sheldon, indeed, expressly states, " I know no instance of fracture of this process by a strong action of the extensor muscles, like that of the patella*."

I have repeatedly inquired of my friends whether they had ever known a fracture produced by muscular action, and have never yet been answered in the affirmative; nor has my own experience furnished me with any such example. From these circumstances, and the uniformity of the language of those writers who mention muscular action as a

* Page 62.

cause of fracture, I am induced to suppose that they may have followed the description of their predecessors, without the confirmation of further experience.

It is then reasonable to suppose, that the occurrence of such an accident is very uncommon: and when it does happen, it is probable that the fracture is near the extremity of the olecranon, where the triceps would exert most influence. Certainly, in the event of such an accident, the retraction of the detached portion of bone, by the continued operation of the triceps, might be expected to follow. But in the more common mode in which this accident occurs, namely, by the direct application of violence to the base of the olecranon, with the arm in a state of flexion, the force does not necessarily displace the broken portions directly, nor does it follow that any consecutive retraction should take place from the spasmodic action of the triceps. As no violence is done to that muscle, there is no reason for its being thrown into spasm: and, generally speaking, any breach of continuity in a bone is accompanied with such a consciousness of inability to move the limb, that it requires a considerable effort

on the part of the patient to will the muscles to act, and often the power of doing so is not at all under his control. Of this fact I am quite certain from repeated observations. It is true that authors speak of the "*contractilité toujours agissante de ce muscle*;" but the same writers speak of the great freedom of motion laterally, which the retracted portion admits of: an inconsistency which appears difficult to reconcile, and which, I believe, will not be borne out by experience.

In addition to the absence of any undue spasmodic action of the triceps, which is necessary to cause this displacement, we have the positive resistance to any such displacement afforded by the hollow in the posterior part of the humerus, into which the point of the olecranon is received*; and further, by the lateral attachments of

* Sheldon, in speaking of this cavity, uses the following strong and decided expressions:—"The posterior semilunar cavity, which is situated between the two condyles of the os brachii, will fix the separated portion of the fractured olecranon so steadily as to prevent any elongation or redundant callus. No splints, or other inventions of the chirurgic art, can possibly retain it in such accurate apposition as the proper cavity formed by nature to receive it." Page 74.

the firm aponeurotic expansion of the tendon of the triceps, and by the fibres of the external and internal lateral ligaments, which are attached to the olecranon, and which are rarely torn through, or destroyed, at the time of the accident.

It is not here meant to be asserted that retraction of the olecranon after fracture does not take place in some instances, but that it is by no means a constant, nor a necessary consequence of the accident. Sir A. Cooper says, that “so soon as the extremity of the bone is broken off, it is, by the action of the triceps muscle, drawn up from half an inch to two inches from the ulna, and the extent of its separation depends upon the degree of laceration of the capsular ligament, and of that portion of the ligamentous band which proceeds from the side of the coronoid process of the ulna to that of the olecranon.”

If the capsular ligament was the principal support of the fractured portion, it is probable that retraction would be much more frequent, and to a greater extent, than it usually is; as, strictly speaking, the capsular ligament could afford but little re-

sistance, both on account of its looseness and want of strength. What ligamentous band Sir Astley alludes to, I am rather at a loss to understand. There are, indeed, some few fibres of aponeurosis, which extend over the surface of the ulna at the base of the coronoid process and olecranon, but I have not been able to detect any distinct ligament on dissecting the joint, nor do I find any such mentioned by Soemerring, or any other author.

The powerful aponeurotic expansion of the triceps, the lateral attachments of the anconeus, and the other restraints mentioned above, appear to be far more efficient obstacles to the degree of retraction than those enumerated by Sir A. Cooper. In those instances which I have seen, in which a slight retraction had taken place, there was little or no difficulty in replacing the fractured portion into its proper cavity, the mere relaxation of the triceps and the lightest manipulation has effected it. The first case recorded by Desault strongly corroborates this :—“ Il y avoit, entre le cubitus et l'olécrâne un enfoncement dans lequel on portoit aisement le doigt. Cet enfoncement

augmentoît quand on rendoit la flexion de l'avant-bras plus grande, ou lorsque le malade faisoit contracter le muscle triceps; *il diminueoit au contraire, et même disparissoit*, lorsque en étendant l'avant-bras le malade mettoit le muscle triceps dans l'inaction*."

Doubts are entertained by some practitioners of the possibility of obtaining bony union in cases of transverse fracture of the olecranon, and Sir Astley Cooper appears inclined to this opinion.

"With a view," he says, "to understand the nature of this accident, and its means of reparation, he tried the following experiments:—With a knife and mallet he cut through the olecranon of a dog; a separation of the bone immediately took place by the action of the triceps, adhesive matter was effused; and, on examining the limb a month after, the bone had united by strong ligament. The same experiment was tried on several rabbits with similar results."

With all deference to the high authority of Sir Astley Cooper, it does not appear to me that any light has been thrown on the

* Journal de Chirurg., tom. i. pp. 48, 9.

subject by these experiments. In the first place, the injury which he inflicted was totally different from what occurs in common fractures. He completely severed the process of bone from its natural lateral attachments, and made a compound fracture into the joint. Of course, there being no resistance to the triceps, which would be thrown into strong action during the animal's struggles to escape, considerable retraction followed; and no attempts being made to restrain the motions of the limb, or to maintain the broken surfaces in contact, no bony union took place: surely such a result might have been fully anticipated. I would take the liberty to add further, that the analogy between the olecranon of man, and the animals above mentioned, on whom the experiments were tried, is very imperfect. In man, the lunated process of bone, called the olecranon, in the extended state of the arm, is deeply sunk in the hollow between the condyles of the humerus, even to its very extremity; and it is confined in that situation by the lateral attachments which have been enumerated above. In the dog and rabbit, there is a considerable projection

beyond this lunated portion, which forms the hinge-like joint; and although its surface towards the humerus is contained within the capsular ligament, yet its lateral attachments are so loose, to admit of the extensive range of motion which it performs in flexion and extension, that, when severed from the rest of the ulna, there would be scarcely any resistance to the action of the triceps. This projecting process acts as a lever to assist in extending the forearm, and is so long that it may be detached independently from the lunated portion, which more strictly resembles the olecranon in man: but even supposing that, in Sir Astley's experiments, he detached the olecranon so low as to remove the lunated portion, the triceps, acting on the extremity of the lever, would very readily overcome any slight opposition arising from the depression in the humerus, which in the rabbit is very shallow at its upper part, and covered by smooth cartilage and synovial membrane.

Another experiment is mentioned, in which a longitudinal oblique fracture was made, which admitted the broken surfaces to remain in contact; and under these cir-

cumstances, it readily united by bone. And so, no doubt, it would in every case of transverse fracture, provided the broken surfaces were steadily maintained in correct apposition. In order to obtain this, several circumstances require to be attended to.

The great object to be attained, is to bring the fractured surfaces so accurately in contact, that they shall exactly correspond both at their external and internal edges; for it is obvious that any inequality must be productive of more or less detriment to that which is strictly a hinge-like joint. If the inner edge of the fracture, which is applied over the surface of the trochlea, at the extremity of the humerus, be separated to any extent by the intervention of ligamentous matter or callus, the proper relation which the articular surfaces ought to hold will be deranged. In addition to which, the extremity of the olecranon being pressed upwards and backwards, and uniting in this situation, would not be accurately adapted to the hollow between the condyles of the humerus; and thus the natural functions of the joint would be much impaired.

On the other hand, any separation or

interval at the outer edge would effectually prevent the due degree of extension ; for, in that case, the extremity of the olecranon would come in contact with the bottom of the depression, above mentioned, before the forearm is fully extended.

Any lateral displacement of the detached portion of the olecranon is likewise to be guarded against ; as the correct adaptation of the articular surfaces would be thereby disturbed, and the free motion of the joint interfered with. It is probable that it was the contemplation of this circumstance, of the possibility of imperfect bony union taking place when the bones are very nearly in contact, but not accurately adapted to each other, that induced Camper to recommend that no attempt should be made at bony union, and that the limb should be daily used. “ Agglutinationem,” he says, “ moliri non debet chirurgus, sed sublatis tumore et inflammatione quieti et remediis aptis, cubitum quotidie prudenter movere, et unio per tricipitis tendinem, sue per concrectionem membranosam formetur, *et os ossi non admoveatur**.” In support of his opinion he

* Petr. Camper de Fract. Patellæ et Olecrani, p. 66.

quotes the following passage from Celsus :—
 “ Quod si ex summo cubito quid fractum sit, glutinare id vinciendo alienum est, fit enim brachium immobile*.” The experience, however, of Camper, in these cases, appears to have been very limited, since he acknowledges that “ Bis tantum in vivis hanc fracturam videre contigit†.” And he appears not to have considered, that at the time when Celsus wrote, the arm was kept in a state of flexion; which was the practice constantly pursued, until Duverney, in France, and Sheldon, in this country, introduced the present improved method; and the latter author particularly mentions a rigid immoveable arm as the constant consequence of a fracture of this process, when the then common method of treatment was pursued.

The question is, Cannot all these unfortunate circumstances be avoided by proper treatment, and will not perfect bony union take place, if the case be so managed that the bones are maintained in correct apposition? There can be no reasonable

* Lib. viii. cap. 10.

† Op. cit. p. 64.

grounds for doubting the possibility of effecting this in the majority of recent cases, although it may be difficult to accomplish it in cases which have been neglected for some time, and in which considerable retraction has taken place; accompanied with inflammation and swelling. It will, perhaps, admit of a question, whether, in such cases, it may not be better to allow ligamentous union to be accomplished, leaving some space between the separated portions of bone, than to attempt to bring the bones more nearly together, which may be followed by the inconveniences and impaired motion above described? My own experience does not afford any such example; but I have seen cases in which a slight interval has existed between the fractured surfaces, which have been attended by impaired motion for a considerable time subsequently to the union.

It remains only to speak of the mode of treatment best adapted to fulfil the several indications. As far as my own experience goes, a slight degree of flexion of the elbow, to the extent of about 160 degrees, is the best position, and will admit of the nicest

coaptation of the fractured surfaces ; whilst, at the same time, it is the least irksome to the patient. In the treatment of all fractures, it is an essential object to place the limb in as easy and natural a position as possible, consistently with the security of the broken bones. There is much less probability of spasmodic muscular action, and of inflammation of the synovial membranes of the neighbouring joint, when this is attended to, than when the limb is forcibly confined in a strained and unnatural situation.

In the present case, a state of moderate flexion is the most easy position, and the one in which the arm hangs in a state of natural repose. More complete extension, with a straight splint in front of the arm and forearm, which is the method of treatment recommended by Sir A. Cooper, and some other practitioners in this country, appears liable to several objections ; the validity of which I have myself witnessed in several instances. In the first place, the arm in a natural state will very seldom admit of perfect extension to a straight line, as the extremity of the olecranon, in most persons, strikes against the bottom of the hollow in

the humerus, before the forearm can be brought into the same line of direction as the arm. When a fracture of the olecranon has taken place, the forearm can be carried backward beyond its natural boundary, in consequence of the breach which has taken place between the shaft of the ulna and the process which checks the extension, in the manner above described. The binding the arm, under such circumstances, on a perfectly straight splint, not only causes uneasiness, from forcibly extending the ligaments and muscles beyond their natural state, but often causes more permanent injury, by widening the breach at the inner surface of the fracture, in consequence of the pressure made at the outer edge.

Desault was aware of this circumstance, and guarded against it in his practice. In speaking on this subject he says: — “ Si les fragmens se touchent et sont affrontés postérieurement, ils laissent entr’eux un vide manifeste en devant, de-là une épaisseur du cal plus grande dans ce sens que dans le premier, et par suite une gêne plus ou moins sensible dans les mouvemens *.”

* Desault, par Bichat, tom. i. p. 170.

Another objection to the state of forcible extension has been mentioned by Mr. Charles Bell:—“ By extending the arm too much, the olecranon, which has been broken off, is pushed from its notch in the lower head of the humerus; and consequently it does not perfectly and correctly unite with the body of the ulna*.”

The plan of treatment which I have been in the habit of pursuing, with very happy results, has been the following:—After confining the lateral motion of the upper broken portion with a slight compress, and straps of adhesive plaster carried obliquely across the elbow, and having accurately adapted the broken surfaces together, I form a case of strong pasteboard, softened with hot water: this is applied in two pieces, about a foot long; one in front, and the other at the back of the arm, which are bound with a circular roller to the arm, bent to an angle of 160 degrees. This is left on until dry, during which time the patient remains in a recumbent posture, with the arm on a pillow. The pasteboard is then removed,

* Charles Bell's System of Operative Surgery, vol. ii. p. 182.

and covered with wash-leather, which is glued over the surface; this gives it a great degree of solidity, and forms a very light and commodious case, sufficiently strong to resist any attempt at motion in the joint, and to protect it from any blows or injuries. With the assistance of this apparatus it is not necessary to confine the patient after a few days. With a view to prevent any swinging motion of the arm, and to afford additional security against accidental blows, I have found it advantageous to have a portion of ribbon attached to the front of the patient's dress, with a loop for the thumb or wrist to hang in when in exercise. After a fortnight, or three weeks, slight passive motion may be given to the joint, which will greatly accelerate the patient's ultimate recovery.

ON INJURIES

IN THE

VICINITY OF THE SHOULDER-JOINT:

WITH THE

DESCRIPTION OF AN APPARATUS

FOR THE

MORE EFFECTUALLY SECURING THE UPPER EXTREMITY.

ON INJURIES

IN THE

VICINITY OF THE SHOULDER-JOINT,

ETC. ETC. ETC.

A GREAT variety of accidents occur to the bones which enter into the formation of the shoulder. A little consideration of the mechanism of these parts, and the movements of which they are capable, will much facilitate a correct knowledge of the nature of these accidents, their influence in impeding the natural functions, and the curative indications which should be steadily kept in view in the treatment of them.

The shoulder-joint in man admits of a very extensive range of motion, which enables him to execute the most diversified actions, and contributes to give him such superiority over all other animals. Three bones enter into the formation of the shoulder-joint; the scapula, the clavicle, and

the humerus ; or, more correctly speaking, these three bones are concerned in the various movements of the shoulder, for they are articulated by distinct joints. They are, however, so connected together, that in all considerable movements there is, if I may use the expression, a totality of motion, which must be borne in mind in directing the treatment of the different injuries to which they are liable.

In all these motions the clavicle sustains a very important part. It principally sustains the weight of the shoulder, and consequently of the whole upper extremity, which is rendered particularly manifest by the sinking and falling forwards of the shoulder when this bone is fractured. Placed between the scapula and sternum, the clavicle forms a sort of buttress, which is essential to the different movements of which the upper extremity in man admits. The importance of this bone is negatively proved by the confined sphere of motion in the anterior extremities of animals that do not possess a clavicle. So likewise, in any fractures of that bone occurring between the coracoid process and the sternum, a person loses the

power of raising his hand to his head, and the circumduction of the arm is entirely prevented. The articulation of the clavicle with the sternum is in fact the only firm basis of all the motions of the shoulder. This is well illustrated in circumduction of the arm, which combines all the movements which the shoulder-joint is capable of executing. In this action the clavicle describes a cone, of which the apex is at the sternal extremity, and the base is traced by the scapular extremity.

The clavicle, from its prominent situation and extensive motion, is particularly liable to fractures and dislocations. It is obvious, from the important functions which it performs, that it is very desirable to remedy these accidents as far as possible. It is true that patients will recover good use of their arms after union has taken place, with considerable displacement of the broken bone; but we ought not to rely on this indulgence in nature, who, on so many occasions, accommodates herself to the errors of bad surgery. In the female, any irregularity in this bone is very unsightly, and in man it may be productive of very

serious consequences, and even of paralysis, from the pressure on the subclavian vessels and nerves.

A case of this latter description I published in the 7th volume of the Medico-Chirurgical Transactions, in a paper on the influence of the nervous system in the production of animal heat.

In fractures occurring at the scapular extremity of the clavicle, between its double attachment to the acromion and coracoid process, little or no displacement can take place in the fractured portions, except such as is produced by the application of the force which causes the fracture; which, in all these cases, is applied directly to the spot, and causes so much swelling and injury to the soft parts that the fracture is often not detected.

When fracture occurs between the coracoid process and sternum, very considerable displacement may take place; arising partly from the action of the clavicular portion of the sterno-cleido-mastoideus muscle, which slightly elevates the sternal portion of the clavicle, whilst the weight of the whole upper extremity, and the action of the pectoralis

major and subclavius muscles depresses and carries forward the scapular portion to such an extent that often one portion appears to ride over the other.

In the treatment of these cases the principal indications are to elevate the shoulder even, in some cases, beyond its natural level, to allow for the action of the sterno-cleido-mastoideus muscle; to keep the shoulder drawn outwards from the body, by a wedge in the axilla; and to maintain the whole limb in a perfectly passive state, as every motion of the arm and scapula must be immediately communicated to the fractured part.

The common mode of treatment employed in this country is the figure of eight bandage; or the modification of it, usually known by the name of Bradsor's corslet.

The only effect of these bandages is to keep back the shoulders; but, at the same time, the scapula is pressed towards the sternum, and the fractured portion of the clavicle being connected with it, is forced under the sternal portion. When a common linen bandage is employed, the tightness with which it is applied causes most distressing excoriations in the axilla; and gene-

rally some folds of it press so much on the scapular end of the clavicle as to depress it, and thus produce the very defect which it is intended to remedy. In the employment of every form of this bandage, the weight of the whole upper extremity remains unsupported, and it is necessary that a sling should be superadded to support the arm; which, as far as it goes, forms the most important part of the treatment; but common slings are very insecure, they always allow of considerable motion of the arm, and are quite at the patient's disposal to remove or not.

The celebrated Desault was aware of all these difficulties, and endeavoured to overcome them in the following manner: —

He recommended that extension should be made by means of the limb, which is articulated with the fractured bone. This he accomplished, by converting the humerus into a lever, by carrying its lower end forward, inward, and upward, by pushing the shoulder backward, upward, and outward, and by placing a firm cushion under the axilla, to serve as a fulcrum. By this plan the ends of the fracture were approximated

to each other, and all deformity removed. By the employment of between twenty and thirty yards of bandage, curiously and neatly applied, he secured the limb in this position during the cure, and so effectually united the whole extremity with the chest, that they moved together and formed one body.

The principles on which Desault acted were unquestionably correct, and he aimed directly at fulfilling all the rational indications. Unfortunately, however, the means he employed required great nicety in their application, were very readily deranged, and caused most irksome and distressing confinement to the patient, who could not be relieved from the undue pressure or wrinkling of a single fold without disturbing the whole apparatus. These inconveniences were increased tenfold in young females, in persons labouring under dyspnœa, from asthma, or any other cause, and during the heat of summer. Bichat and Boyer endeavoured to simplify this plan, and their modifications are now commonly employed on the continent. These various plans of treatment are rarely followed in this country. I have myself tried them, but found them so ob-

jectionable that I was induced to suggest a plan, which I shall submit to my professional brethren at the close of this paper.

That I may not appear to have hastily adopted any prejudices against Desault's or Boyer's method of treatment, I shall quote the observations of Delpech, who enjoyed ample opportunities of witnessing their application under Desault, Boyer, and other celebrated men, and who very candidly acknowledges their inefficacy. In speaking of the prognosis of fractures of the clavicle, he says:—“ Cette fracture serait peu fâcheuse en elle-même, car il est rare qu'elle soit accompagnée d'accidens graves ; il est même très-facile de replacer les fragmens dans leur situation naturelle ; *mais il est presque impossible de les y maintenir ; en sorte que l'on peut dire que dans l'état actuel de la science, et des procédés de l'art, il est presque impossible de la guérir sans difformité* : ce qui vient de la difficulté de soutenir constamment l'épaule à la même hauteur, et de supporter sans cesse le poids du bras, cause principale du déplacement*.” On the sub-

* Delpech, Précis Elémentaire, tom. i. p. 248.

ject of treatment he says, “ L'appareil doit être entièrement chargé du poids de toute l'extrémité supérieure, et agir dans tous les instans avec la même force pour que la situation de l'épaule soit invariable ; il faudrait, d'un autre côté, que l'on pût réduire à l'immobilité la plus parfaite les parties qui s'articulent avec l'os fracturé. Or, ces deux conditions sont évidemment impossibles à remplir dans leur entier, avec les procédés connus, et il est bien douteux que l'art approche jamais de cette perfection désirable*.”

A little further on he says, “ Nous avons une seule fois réussi complètement à guérir sans difformité ; c'était sur un homme très-patient, qui supporta parfaitement l'appareil pendant soixante jours, et qui passa tout ce temps dans le lit, et presque absolument immobile. Nous avouerons que le malade a dû être fort redevable à ses heureuses qualités. Mais nous déclarerons aussi franchement *que c'est la seule fois que nous ayons vu une fracture de clavicule guérir avec cette perfection, malgré que nous ayons pendant*

* Page 249.

long-temps pu observer la pratique des grands maîtres, et sur un théâtre très-vaste.*

It appears from this evidence, that a simple and efficient method of treating these cases, applicable to females, and to patients under all circumstances, is yet a desideratum in surgery. It is with a hope of contributing to this end that I have been induced to bring forward these observations. As, however, the apparatus which I have employed is applicable to other injuries occurring near the shoulder-joint, it will be better to consider the nature of those accidents, prior to entering on any description of the particular plan of treatment.

The scapula may be broken at various parts, but fracture most frequently occurs either at the acromion, the neck, or the coracoid process.

In fractures of the acromion there is not usually much displacement; although, on comparison with the opposite limb, the injured shoulder will be found to terminate more abruptly, and pressure on the part causes considerable pain. This fracture is

* Page 280.

always produced by the direct application of force from falls or blows. The aponeurotic expansion of the trapezius and deltoid muscles, maintains a connexion between the fractured surfaces, and prevents the external portion from being detached by the action of the deltoid; whilst the head of the humerus, which is retained in its articulation by its natural connexions, supports the fracture below. These two circumstances influence this accident so much, that there is only a bending down of the outer portion of the acromion, which can be restored to its proper level by separating the arm from the side and relaxing the deltoid. If the hand be applied over the shoulder in making this trial, a slight crepitus may generally be detected.

In treating these cases it is necessary that the whole upper extremity should be so united with the trunk that they should move together: it is further necessary to relax the deltoid, by separating the elbow from the side, and that the elbow should be supported in this position. To effect these objects, with the ordinary means now employed, is very difficult; and the plan

recommended by Desault and the Parisian school, is liable to all the objections enumerated in cases of fracture of the collar-bone.

This has led many practitioners to prefer retaining their patients in bed during the whole treatment, and keeping the arm elevated to a considerable angle. Delpêch, in speaking of this accident, states, “ *Cependant à moins de faire garder le lit au malade, il est bien difficile, que le bras soit constamment soutenu avec l’exactitude nécessaire**.”

Confinement to bed during the whole treatment is, however, very irksome, and is far from ensuring success, as it affords no security against motion in the injured extremity. It appears to me that all the necessary objects can be attained, by a modification of the plan which I shall shortly describe, without subjecting the patient to any such restraint.

When the neck of the scapula is broken, the weight of the arm causes it to drop so considerably as to give the limb the appear-

* Delpêch, *Op. cit.* p. 242.

ance of being dislocated; and forcible attempts at reduction have not unfrequently been made. The real nature of the accident may, however, be detected by the facility with which the arm can be raised, so as to bring the head of the humerus to its proper level, and by the reappearance of the symptoms of dislocation immediately on removing the support. In making this attempt a crepitus is also occasionally to be felt.

The indications of treatment in this case are very simple: they consist in raising the shoulder to its proper height; in taking off the weight of the arm, and entirely preventing any motion in the scapula and upper extremity.

When the coracoid process is fractured, there is generally much injury done to the soft parts, which requires to be attended to, for the fracture is generally caused by some direct violence, as blows from the pole of a carriage. In treating these cases the humerus should be inclined towards the sternum, to relax the coraco-brachialis muscle, and the limb should be confined in that situation.

In fractures occurring in other parts of the scapula, the great principle to be ob-

served in the treatment is to prevent any motion in the upper extremity, and particularly to restrain the action of the arm forwards or backwards; in which motions the scapula accompanies the humerus, and moves to considerable extent.

From the brief sketch which has been given of the nature of these different accidents, and the curative ends which should be attained, it is obvious that the leading principle in all, is so to unite the whole upper extremity with the trunk that they may form one body, and move together; as it is not possible effectually to restrain the motion of one part whilst the other is left at liberty, in consequence of the totality of motion in the scapula, clavicle, and humerus. The next important object is to be able to support the elbow firmly in whatever position the nature of the individual case may require. The method employed by Desault has been shown to be correct in principle, but defective and objectionable in practice; and, in addition to the imperfections already pointed out, the impossibility of making any application of leeches or other remedies to the shoulder, which is

often severely bruised and inflamed, should not be overlooked.

With a view to obviate these difficulties, and at the same time to fulfil the various indications pointed out, I constructed the following apparatus, which I have successfully employed in fractures of the clavicle, and fractures of the neck of the scapula.

The apparatus consists of a strong sleeve, made of double jean, or linen cloth, which reaches from half-way up the upper arm, is fitted to the elbow, when bent to an angle of about 75 degrees, and terminates, like the sleeve of a straight waistcoat, in a cul-de-sac. This is applied to the arm, and secured by straps, or a lace and eyelet holes: at the extremity of this sleeve a band of strong webbing is attached, which is passed round the body, and fixed to a broad buckle, which is fastened to a belt of calf-skin, lined with wash-leather, about three inches broad, which is passed round the injured arm, just below the insertion of the deltoid. The action of this sleeve and strap is to prevent any motion in the arm or forearm, and to bind it firmly to the trunk. To support the elbow in any posi-

tion which may be required, I employ a leather cap, adapted to the extremity of the elbow, and hollowed out at its centre for the olecranon. This is put on over the sleeve, and from it two broad bands of webbing pass obliquely up to the opposite shoulder; one in front of the thorax, and the other behind. These bands are affixed to two broad buckles, which are attached to a leather shoulder cap, made of calf-skin, well padded and lined with wash-leather, which is adapted nicely to the shoulder by means of a buckle and strap, which passes under the axilla. By tightening or slackening these bands, the elbow may be either confined close to the side, or brought forward, as in the position required for fractures of the clavicle or the coracoid process; and it may be permanently and steadily fixed in that position. Another strap may be brought down from the anterior oblique strap, and passed round the wrist, to assist in supporting the weight of the extremity.

The advantages proposed in this apparatus are, greater security to the fractured limb, and greater comfort to the patient. The drawing from the point of the elbow

to the opposite shoulder, and fixing the bands to buckles, gets rid of the galling of bandages across the root of the neck and over the shoulder; which, in persons with irritable skins, so constantly follows the application of rollers: whilst, at the same time, it is much more secure and less likely to slip than any bandages. The sleeve being rather loose, allows of some motion in the fingers and forearm; whilst the band, which passes round the body, and is fixed to the belt just below the axilla, in the affected arm, most effectually restrains all motion in the arm and shoulder, and keeps back the upper part of the humerus. There being no circular bands round the chest, the objections stated to arise from the use of Desault's plan, in females and persons with difficult respiration, are obviated; for the band, which passes obliquely across the front of the chest, may always be made to pass between the mammæ without pressing on either. Another advantage proposed by this apparatus is the opportunity afforded of observing the affected shoulder, and making any applications which may be deemed re-

quisite, without in the least deranging the apparatus. In fractures of the clavicle it will be right to employ a pad, or firm cushion, under the axilla, for the purpose of throwing out the shoulder, in the same manner as proposed by Desault. So likewise, in fractures of the acromion, a cushion may be interposed between the inner condyle of the humerus and the chest, to throw out the elbow and relax the deltoid: these modifications will not interfere with the simplicity of the apparatus, and are what a judicious practitioner would employ under any circumstances. When this apparatus is properly adapted, the whole limb is so firmly and securely fixed that the patient may be allowed to rise from his bed, and follow his usual avocations, after a few days have elapsed, and any inflammatory symptoms which may have presented themselves have been allayed.

This apparatus is applicable in other injuries about the shoulder, where perfect rest and any particular position are essential: as for instance, in compound dislocations of the shoulder, and particularly

in dislocations of the clavicle ; which are so rarely perfectly restored, that Sir Astley Cooper is in the habit of stating to his pupils, at the conclusion of his lecture on this subject : —

“ You are not to expect that the parts, after the utmost care in the treatment, will, in dislocations of either end of the clavicle, be very exactly adjusted ; some projection, some slight deformity will remain ; and it is necessary, from the first moment of the treatment, that this should be stated to the patient ; as he may otherwise suspect that it has arisen from your ignorance or negligence. You may at the same time inform him, that a very good use of the limb will be recovered, although some deviation from the natural form of the parts may remain, in a slight projection on the sternum, or some elevation of the sternal extremity of the clavicle *.”

I have never yet had an opportunity of employing my bandage in a case of this description ; but as the deformity complained

* Sir Astley Cooper on Fractures, &c. p. 408.

of can only depend on the imperfect mode in which the upper extremity has been hitherto secured during the cure, and as the apparatus in question will more effectually confine the limb, without any suffering or inconvenience to the patient for an indefinite length of time, I should hope that it might contribute to a more perfect restoration in future.

Reference to PLATE II.

Fig. 1. A front view of the apparatus for securing the whole extremity in injuries of the clavicle and scapula.

A A. The linen sleeve for the arm and forearm of the injured limb.

B. The shoulder cap, for the attachment of the front band C, which draws from the elbow cap D, and is fixed to the buckle *e*.

E. The circular leather band, for the attachment of the band G, seen in fig. 2, which is continuous with the linen sleeve A.

F. A band to assist in supporting the weight of the hand and forearm.

Fig. 2. A back view of the same apparatus.

A. The termination of the sleeve.

B. The shoulder cap.

C. The posterior band, for drawing from the elbow cap D, to the buckle *d*, on the shoulder cap B.

E. The circular leather band for the upper arm; to which the band G, which is

continuous with the sleeve A, is attached at the buckle H.

Fig. 3. A view of the shoulder cap B, which is made of calf skin, fitted to the form of the shoulder, and well padded on its under surface; *a*, the band, well padded and covered with wash-leather, which passes under the axilla, and is attached, by the strap *b*, to the small buckle *c*.

d. Buckle for the attachment of the band C, seen in fig. 1.

e. Ditto, for ditto, in fig. 2.

ON THE
RE-ESTABLISHMENT OF A CANAL
IN THE PLACE OF
A PORTION OF THE URETHRA
WHICH HAD BEEN DESTROYED.

Read before the Royal Society, April 12, 1821.

THE following Papers were published in the Philosophical Transactions for the years 1821 and 2; but as the subject has not been treated of in any professional work, I have thought proper to republish them.

ON
THE RE-ESTABLISHMENT,

ETC. ETC.

IF any apology be requisite for bringing forward the following insulated fact, I hope it will be found in its tendency to throw some light on an interesting physiological subject, which has lately occupied the attention of this learned Society, as well as in its novelty and general importance*.

Of all the complaints to which the human body is liable, there is, perhaps, no class more productive of corporal and mental suffering, than the various affections of the male urethra. For it is most obvious, that any deviation from healthy structure in that part, which, from its peculiar function, is

* See Mr. Bauer's Observations on the Structure of the Urethra, in a paper of Sir E. Home's, in the Philosophical Transactions, for the year 1820.

called into action after very short intervals of repose, must, from that circumstance alone, be productive of almost constant suffering; while the mind of the patient is also depressed from the effect of a continual anticipation of pain, and the apprehension of impaired virility.

The following is a statement of the result of a new operation in a very aggravated case, by which an individual has been raised from such a state of despondency to one of comparative happiness.

John Whitaker, whilst serving on board his Majesty's ship *Pylades*, off the island of Sardinia, in May 1813, when returning on board from *Magdalena*, fell with one leg on each side of the boat, the stem of which injured his urethra so much in the perineum, that he was obliged to have the catheter introduced for above six weeks. From that time he continued to experience more or less difficulty in discharging the contents of the bladder until the beginning of May, 1819, when he was attacked with a sudden retention of urine, which was soon followed by extensive effusion into the cellular substance. Before he could obtain surgical

assistance mortification had taken place, and the integuments in the perineum, with above an inch of the canal of the urethra, had sloughed away. A free vent being thus obtained, the mischief did not extend itself to the scrotum. During the healing process, the medical gentleman who attended him made several unsuccessful attempts to unite the integuments over a catheter.

He came under my care the following August, in St. Bartholomew's Hospital; at which time a large smooth cicatrix occupied the place of the urethra, no vestige of which remained at that part. The mucous membrane of the canal was distinctly visible, terminating above, and recommencing below, the cicatrix. Through the posterior aperture the whole of the urinal and seminal discharges came away, while the anterior portion of the urethra, particularly that part which passed behind the scrotum, was increased in density and much contracted, and probably would ultimately have been completely obliterated by disuse.

The man was by trade a carpenter; and, as he was obliged to work, it was a very serious inconvenience to him every time he

obeyed the calls of nature. This, coupled with the distressing excoriation attendant on the scattering of the urine, made him anxious to submit to any plan of treatment which afforded a possibility of relief, and I determined on pursuing the following one.

The integuments on the right side had suffered less extensively than those on the left; so that when a catheter was introduced, that portion which passed across the cicatrix could be about half covered by drawing the skin and cicatrix from the right towards the opposite side. My first attempt, therefore, was to encourage this disposition in the integuments to fold over; and as some delay was requisite in order to dilate the anterior part of the urethra with bougies, he was directed to remain in bed with his knees tied together over a pillow, and a truss was so applied as constantly to press the integuments from the right to the left side*. To

* I constructed a similar truss some years before, for the relief of a female suffering under incontinence of urine, from a fistulous opening at the neck of the bladder, and have since successfully employed it in three cases. It consisted of a spring, which passed round the front of the body above the pubes, and fastened with a strap behind.

this plan the ultimate cure of the patient is in some measure referrible.

After some weeks, the urethra being sufficiently dilated to admit a moderate sized catheter, I determined to attempt the following operation:—The smooth cicatrized surface having become insensible to the irritation of the urine, I resolved to employ it in the formation of a canal, and to endeavour to connect by it the two portions of the urethra: for, as many months had elapsed since the healing of the wound, all contraction in the cicatrix had ceased, and it was probable that a passage formed of such parts would not be liable to any farther diminution in its calibre.

On the other hand, I had to contend with two great difficulties: in the first place,

From the centre of the truss a fine spring descended, taking the necessary curve to pass under the arch of the pubes, and terminating in an oval pad covered with oil silk, about an inch in length, and half an inch wide. I have very lately relieved a young woman, who had submitted to six applications of the actual cautery under M. Dupuytren, and who was discharged incurable from the Parisian hospitals. Since she has worn this truss not a drop of water has passed, and I entertain confident hopes that the aperture will close.

the portion of cicatrized integument intended to be separated, was not of original formation; consequently, it was endued with less vital energy, and possessed fewer blood-vessels: secondly, it was not possible to allow the parts to be at rest for the completion of any curative process for many hours together; the force also with which the urine was expelled, and the acrid nature of that discharge, were alike unfavourable to the cure by adhesive inflammation. All these circumstances having been well considered, a portion of integument was removed, about an inch and half long, and one-third of an inch in width, on the left side of the cicatrix; the groove thus formed being intended to receive the edge of skin to be detached from the opposite side. An incision was then made across the perineum, above and below, so as to pare away the callous edges of the urethra. The cutis was next dissected off from a portion of integument on the right side of the perineum, about an inch and half in length and half an inch broad, leaving a smooth space of rather more than an inch between the cut surfaces, which was intended to form the

lining of the new canal. The integuments on the right side were now dissected up, turned over a catheter, and brought in contact with the opposite groove. The detached portion of cicatrix bled little during the operation, and, before it could be applied to the groove, the edge had so livid an appearance as to create an apprehension that it must perish. Two ligatures were employed to assist in retaining it in the desired position, and some straps of adhesive plaster and a bandage completed the dressings. The day following the operation, it was evident that some urine had escaped by the side of the catheter; and on the third day, when it became necessary to remove the dressings, it was found that the portion of the flesh which had been denuded of skin had sloughed, but that a sufficient quantity had united above and below to form a canal open at one side, and large enough to include the whole catheter.

This result was quite as favourable as could, under all circumstances, have been expected; and I was led to entertain sanguine expectations of ultimate success.

The two surfaces, from whence the integuments had been removed, were now suffered to heal; but as the cicatrix on the right side contracted, it drew the newly formed canal rather to that side, and tended to increase the opening into it. It was, consequently, determined not to attempt any thing farther until all contraction had ceased. So much, however, had been gained by this operation, that when the catheter was introduced, and the finger pressed on the left side, no urine escaped, and some could be made to pass through the penis without the aid of the catheter. My patient, however, soon after this, became much disordered in his health, and had an attack of *lepra vulgaris*, to which he had for years been subject; on which account for some months nothing was attempted, except several times freely exco-riating the edges of the canal, and thus endeavouring to unite them by keeping them in contact. In this we were constantly foiled by the astonishing rapidity with which the skinning process took place from within outwards. This disposition to form new skin was so remarkable, as to excite the sur-

prise of several gentlemen who witnessed it, and appeared to arise from the moist state in which the parts were constantly kept*.

In the summer of 1820, the man had recovered from his cutaneous affection, and his general health was so much improved, that he resolved to submit to a second operation. In this attempt I borrowed integuments from the opposite side to that I had taken them from in my first. A deep groove was made on the right side, the surface was denuded of its cutis to some extent; a considerable portion of integument was then

* In corroboration of this, I have lately employed bread and water poultices to healthy sores, which have skinned over with greater rapidity than under any other application. Since making these experiments, I have learnt that Professor Kern, of Vienna, employs no other local remedy in the cure of ulcers than water and a simple covering of linen. It is a curious fact, that in the sixteenth century, when the art of surgery was encumbered with useless nostrums and complicated instruments, and when the actual cautery and hot oils were the favourite remedies, a similar simplicity of treatment should have been employed by Maistre Doublet, a contemporary of Ambrose Parey, of whom Brantome tells us,

“ Et toutes ses cures faisoit le dit Doublet par un simple linge blanc et belle eau simple de la fontaine ou des puits.”

detached from the left side, and, in order to obtain healthy skin, I encroached a little on the thigh, and laid bare the edge of the fascia lata. Instead of passing any ligature through the detached portion, the old quill suture was employed, which was passed from the two outer cut surfaces. A pad of adhesive plaster was interposed between the ligatures and the flap of skin, to diffuse the pressure more generally ; and my patient, being now quite an adept in passing the catheter, was directed to introduce it about three times in the twenty-four hours, instead of retaining it in the bladder, which had permitted some of the urine to pass insensibly away, and had acted prejudicially in the former operation. By this attempt much more was gained, and about two-thirds of the canal were completed ; still, however, there remained a small aperture at the upper part. We again attempted to close this by denuding the edges with escharotics and the lancet, but it skinned over too rapidly to allow of any union between the opposite surfaces. A third operation on a smaller scale was therefore necessary ; which so nearly completed the cure as to leave only an orifice large

enough to admit a bristle, which has subsequently closed, and, at the present time, (March, 1821,) he remains perfectly well, and is able to expel the contents of his bladder *pleno rivo**.

I may, perhaps, incur the charge of prolixity in the foregoing narrative, but I conceive it important to give a circumstantial account of the whole process, to mention all the difficulties I had to contend with, and the means which were employed to surmount them. Should I ever have occasion to repeat this operation, I should entertain sanguine hopes of succeeding at once, by avoiding some circumstances, and availing myself of others, a knowledge of which could only be gained by actual experiment.

The above case is, I believe, the first on record in which so extensive a portion of the whole canal of the urethra has been restored; and the mode of performing the operation has never, as far as I have been able to ascertain, been resorted to before. Sir A. Cooper, in the second part of his *Surgical Essays*, which was published soon

* Since the above was written he has continued perfectly well: he is now married, and a father.

after my first operation on Whitaker, has given an account of two very interesting cases, in which he succeeded in closing unnatural openings in the urethra. In neither, however, of the cases which he has related, was the breach so extensive, nor did it occupy the whole canal. The second case, related in page 207, approaches nearer to Whitaker's than the first. In this instance the opening was anterior, but close to the scrotum; and Sir Astley availed himself of this circumstance in effecting a cure; a portion of the skin of the scrotum was partially detached, and turned over so as to cover the opening, the callous edges of which were previously pared away. The operation in this case differed materially from the one which I performed; for, in Sir A. Cooper's case, the raw surface was turned towards the urethra, whilst in mine the canal was wholly formed of a previously cicatrized smooth surface, which had undergone its utmost degree of contraction before it was employed to form the canal.

The fact I conceive is new, that, from a cicatrix of common integuments, a canal may be formed capable of conveying so

acid a fluid as urine, and of fulfilling *all* the functions of a healthy urethra, without being liable to any subsequent variation in its calibre. It is important, also, in throwing some light on the still disputed question of the muscularity of the urethra; for, since the patient quitted my care, he has more than once indulged in sexual intercourse; and he assures me, that the jet of semen is as forcible as before the accident. When we consider that nearly, if not entirely, the whole of the ejaculator seminis must have sloughed away with the portion of the urethra which perished, and that an interval of above an inch of common integument at present exists between the two portions of the meatus urinarius, it is difficult to account for this phenomenon. It is probable, that the semen is in the first instance projected into the urethra with some impetus, and it would there immediately receive additional impulse from the spasmodic action of the levator ani and other muscles in the neighbourhood of the urethra; but the *vis à tergo* must be nearly, if not entirely, lost in its passage through the portion of integument in the perineum. It must then depend for

its final projection, either on the muscular fibres, which have been described by Mr. Bauer as surrounding the mucous membrane of the urethra at its anterior part, or on the elastic property which has been assigned to it. If I might venture to offer an opinion on the subject, I should consider the present case rather in favour of the muscularity of the urethra, as the quantity of fluid secreted is hardly sufficient to distend the whole canal; a circumstance very essential to the reaction of an elastic tube. From the tortuous course of the muscular fibres, as described by Mr. Bauer in Sir E. Home's paper, it seems probable that they would require to be elongated before they could act with force; and precisely such would be the effect of the injection of blood into the corpus spongiosum which takes place in coitu.

One more circumstance I may venture to allude to, as tending to support such an opinion, namely, the complete emission of the contained fluid which takes place, which requires a forcible and very sensible contraction of the whole canal, and cannot be accounted for on the supposed principle of

elastic compression, unaided by muscular action.

On reflecting on the preceding case, it appears to me not less important in a practical than a physiological point of view; for the curative principles which were acted on, may lay the foundation of an improved mode of treating some of the more lamentable cases of strictures, with fistulous openings and diseased integuments in perineo. It is well known that such cases occasionally baffle the skill of the ablest practitioners, and often terminate in premature death, after years of continual suffering. When we consider that that part of the urethra situated opposite the perineum is by much the most frequent seat of disease, and that it is often confined to this situation, it is probable that, in such cases, if we could remove the diseased portion of the urethra, together with the thickened fistulous integument, much good might be effected; and, perhaps, even a permanent cure might be accomplished, by subsequently pursuing a somewhat analogous operation to the one performed on Whitaker. Such a practice would, I conceive, be justifiable on two

grounds. In the first place, the patient's state is nearly hopeless from all common plans of treatment, and should the operation not eventually succeed, he will not be rendered worse; for, instead of making water through numerous fistulous apertures, and being subject to frequent depôts of urine and the formation of fresh abscesses, he would at once empty his bladder from the extremity of the membranous part of the urethra: and farther it may be urged, that no parts of vital importance would be endangered by the operation. It is true, that such a plan would be both painful and tedious, but I should still consider it worth the experiment, after in vain trying all the usual modes of relief. The case just related, and the success which attended Sir A. Cooper, encourage us to hope that, in many cases which have hitherto been abandoned as incurable, much good may yet be effected by judicious treatment, and a right application of the known laws of the animal economy. Should future operations be equally successful, the borrowing from one part of the body to repair the loss of another, must be considered as one of the happiest modes

of directing the reparative processes of nature; for the closing of large fistulous openings in the male and female urethra, must certainly be acknowledged as contributing more essentially to the happiness and comfort of an individual, than almost any other operation in surgery.

ON
THE MECHANISM OF THE SPINE.

Read before the Royal Society, April 25, 1822.

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ON

THE MECHANISM OF THE SPINE.

HAVING been lately engaged in examining the structure of the vertebræ in different animals, I have been particularly struck with the mechanism of the spine and spinal canal in birds, by which a most remarkable degree of motion is gained in the neck, without any injury or pressure on a part of such vital importance to the existence of animal life as the spinal marrow; an extent of motion, so great, indeed, as completely to compensate for the deficiency of it in the dorsal and lumbar regions, as well as for the want of any prehensile power in the anterior extremities. In attempting to explain the nature of this peculiar mechanism, which tends to throw considerable light on the physiology and pathology of the spine, I believe that I have not been

preceded by any author. The cervical vertebræ in birds are very numerous, varying from nine to twenty-four*. They differ considerably from one another, according to their situation, in the form and direction of their articulating surfaces, and in the number and shape of the different processes, which afford extensive means of attachment to the muscles concerned in the different motions of the neck. Unlike the vertebræ in man, and most of the mammalia, they are articulated together by complicated joints, which bear a close resemblance to the articulation of the olecranon with the humerus in the human subject, but differing in some respects; the vertebræ in birds admitting of lateral motion as well as flexion and extension, whilst the elbow is strictly a hinge-like joint.

The varying position of these articular

* This great diversity in the number of the cervical vertebræ in birds, is the more remarkable, when contrasted with the uniformity which pervades the class mammalia, where the number (with one single exception, the three-toed sloth,) is constantly seven. The mole, whose head appears lost between the scapulæ, has precisely the same number as the giraffe and the horse.

surfaces is greatly favoured by the interposition of a cartilage, which is curiously adapted to the surface of each bone, and is enclosed between reduplications of synovial membrane; and thus each joint is double, consisting of two synovial cavities, and is analogous to the articulation of the lower jaw and sternal extremity of the clavicle in man.

The canal of each vertebra is of very unequal calibre, the centre being narrowest. It enlarges above and below, and at each joint is nearly three times the capacity that it is in the centre; and thus the canal of each individual vertebra may not unaptly be compared to an hour-glass. The canal is closed in front by the posterior surfaces of the bodies of the vertebræ, but behind it is very imperfect; and in the skeleton there is a large lozenge-shaped opening, formed by the diverging inferior articular processes and the converging plates, which unite to form the back of the canal. This, in a recent state, is filled up by a membrane, and is protected by the highly elastic and powerful *ligamentum nuchæ*.

This mechanism, besides allowing of the

greatest possible freedom of motion, appears to be intended, at the same time, to guard against the possibility of any undue pressure on the spinal marrow. This is very readily demonstrated by removing the ligamentum nuchæ and membrane which closes the above mentioned opening. The spinal marrow, enveloped in its membranes, will immediately come in view. Its outer membrane is very vascular, and of a delicate structure, and is connected with the canal by a fine filamentous cellular substance: it is larger than the inner membrane, with which it is but loosely connected.

When the spinal canal has been thus exposed, the individual vertebræ may be bent backward to a right angle, and laterally to an angle of 45° , without in the least compressing the marrow which occupies so small a space of the whole calibre of the canal at each articulation, as to be quite secured from any injury from this motion. The design, in this structure, becomes even yet more obvious, on viewing the whole extent of the spinal cord. It is nearly of the same size throughout, diminishing very gradually from above downwards, and completely

occupies the narrow central part of the canal of each cervical vertebra, where no motion can affect it. The same may be observed in that part of the spine which corresponds to the dorsal and lumbar divisions, which in birds do not admit of motion ; for here we find no variation, either in the spinal canal or the marrow, except where the numerous branches are given off to form the great sciatic plexus, to supply the lower extremities, where it swells out into a bulbous shape, corresponding to the cavity in the bone.

Before quitting the subject of the spine in birds, it will be right to mention one more peculiarity, apparently connected with the same mechanism. Contrary to the usual course in other animals, the nerves that are given off from the cervical portion of the spinal marrow, pass obliquely upwards at a considerable angle, through an opening between the root of the inferior articulating process and the body of the bone ; they then divide, and one branch descends through the opening in the lateral process, and the other branch is distributed to the surrounding muscles and integuments.

One principal object in comparative anatomy, or rather in comparative physiology, is to enable us, by examining particular structures, which are more developed in some animals, and in whom, consequently, the functions of such structures are more apparent, to judge of the probable uses of similar structures existing in a diminished proportion in other animals. On investigating this subject, and examining the spines of several other animals, I have found a similar arrangement, varying only in degree, and that exactly in proportion to the extent of motion permitted between the vertebræ*.

In the formation of the spine in man, it was requisite to combine two very opposite

* This rule will be found to hold good, even in those animals which form exceptions, with respect to the general form and arrangement of the different processes. Thus, in the mole, whose cervical vertebræ are mere bony rings without any spinous processes, and which, consequently, admit of extensive motion, the canal is remarkably capacious. In the bat, whose dorsal vertebræ are either wholly without spinous processes, or have only short tubercles, the canal, at this part, is of greater volume than either in the cervical or lumbar vertebræ; and, contrary to the general rule, this division of the spine admits of considerable motion.

qualities. The solidity and strength of a column were required to be united with the flexibility necessary to the performance of our diversified actions. To attain these various ends, this beautiful structure is admirably adapted. The broad horizontal planes afforded by the bodies of the vertebræ, the mechanical locking of the articular processes, and the powerful ligamentous bands which unite them, so connect the whole as to form one column, whilst the numerous articulations into which it is subdivided, which are separated by masses of highly elastic matter, at once interrupt the effect of concussion, and allow a slight extent of yielding of one vertebra upon the other. The motions of the individual vertebra are obscure and limited, but the aggregate of the whole is considerable. The extent of motion varies in each region; in the back, every thing conspires to limit it; but in the neck and loins it is much greater; and in sawing open the spinal canal, we find a very similar provision to that which I have before described in birds, namely, an exact correspondence between the extent of motion permitted, and the size and form of the

canal. Thus, in the dorsal division, where motion hardly exists, its calibre is less ; it is of a rounded form, and it is more closely adapted to the size of its contents. In the superior cervical vertebræ, where the extent of motion is greater, the canal is of a triangular form, and is considerably larger in proportion to the spinal cord. In the lumbar vertebræ it is also triangular, and much more capacious than in the dorsal. Obviously, with the same intention, the theca is very loosely connected with the bony canal, and a considerable space is left between it and the other membranes, to allow of a sufficient play of one surface on the other, so that, at the greatest extent of natural curve, no perceptible stretching of the marrow can take place ; which would be liable to continual pressure, if, closely enveloped in its membranes, it completely filled the canal, in every motion of which it must, in that case, participate.

To afford additional support to the marrow, which this loose state of membranes would leave very insecure, if enclosed in so delicate a tissue as the pia mater of the brain, this membrane, which may be con-

sidered as the proper tunic of the marrow, is greatly thickened, and partakes more of the characters of a fibrous membrane.

The membranous band, which has been termed the *ligamentum denticulatum*, appears to be superadded to restrain the lateral motions of the marrow, and to steady it in the canal. By these membranous processes, the marrow may not, improperly, be said to be lashed to the sides of the spinal sheath, in which, from the disproportion between them, it would otherwise be liable to perpetual variation of position, and pressure from the bony parietes. That a certain degree of freedom of motion between the membranes is essential to the due performance of the functions of the spinal marrow, is proved by the effect of accidents and disease. It would be out of place here to bring forward a detail of particular cases, but I may mention briefly, that I have ascertained, by dissection, that the most distressing train of nervous symptoms, and even complete paraplegia, may be produced by adhesions taking place between the membranes, and by effusion into the canal or theca.

In conclusion I may observe, that this view of the subject tends to throw considerable light on the pathology of the spine, and assists in explaining a circumstance which I have repeatedly noticed in diseases affecting the vertebræ, namely, that the symptoms of irritation and inflammation of the spinal marrow are much more early manifested, and are generally far more serious in their consequences, when the dorsal vertebræ are affected, than when either the cervical or lumbar are the seat of disease. In the former case, the slightest congestion or effusion is often productive of serious symptoms, from the canal being smaller and more completely filled with the marrow and its membranes; whilst, in the latter description of cases, from the greater capacity of the canal and looseness of the membranes, considerable effusion may exist, without, at first, producing any marked symptoms, more particularly in the lumbar region, where other circumstances concur in rendering the effect of pressure less sensibly felt; to enter into a description of which would be foreign to the object of this paper.

As it is difficult to convey any clear idea of complicated forms by words, I have subjoined a sketch of some cervical vertebræ in birds, with a description of the different parts.

Explanation of PLATE III.

Figure 1. Represents an interior view of a single cervical vertebra.

Fig. 2. A posterior view of the same.

Fig. 3. A lateral view of the same.

Fig. 4. A front view of two vertebræ articulated together.

Fig. 5. A back view of the same.

The letters of reference are the same in all the figures.

A. The body of the vertebra.

B B. Lateral processes.

C C. Styloid processes, with tubercles near their base, which restrain the motion of the vertebræ in the anterior direction. In some birds, at the upper part of the neck, a bony arch extends from one to the other, to preserve the blood-vessels which pass under it from pressure. This is the case in the heron, and other very voracious birds.

D. Lunated excavation for articulation with the superior vertebra.

E. Semi-lunar convexity, corresponding to the excavation above mentioned.

F F. Diverging inferior articular processes, with surfaces facing obliquely outward.

G G. Superior articular surfaces, facing obliquely inwards.

H. I. Spinal canal, imperfect in the skeleton, in consequence of the vacancy left between the diverging inferior articular processes and the superior converging plates, which unite to form the back of the canal K.

L. Opening for the passage of the spinal nerves.

M. Foramen for the passage of the carotid artery and branches of the spinal nerves.

Fig. 6. A perpendicular section of two vertebræ, showing the interarticular cartilages.

THE END.

LONDON:

PRINTED BY J. MOYES, GREVILLE STREET.

ERRATA.

Page 44, last line, *for* first order, *read* third order.

— 71, line 3, *dele* that.

— 74, line 16, *dele* that.

— 83, three lines from the bottom, *for* a e, *read* arc.

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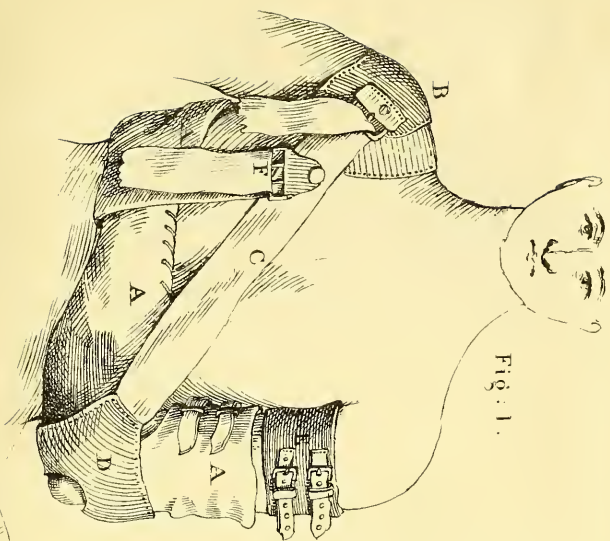


Fig: 1.

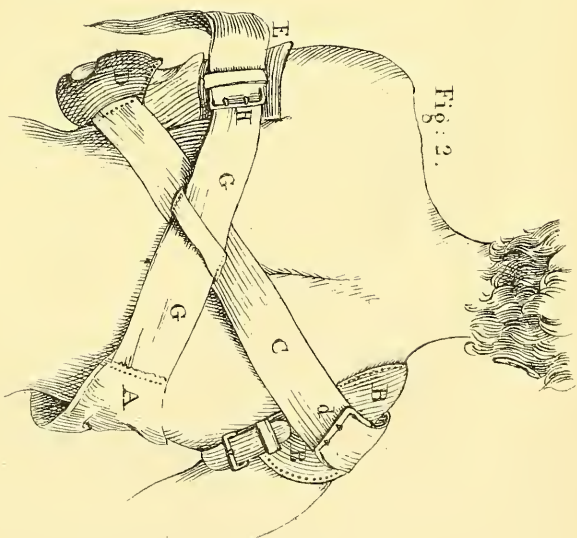


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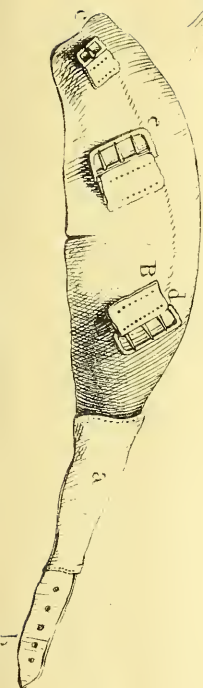


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Fig. 1.

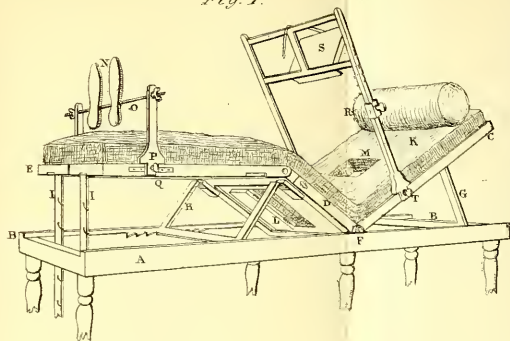


Fig. 2.

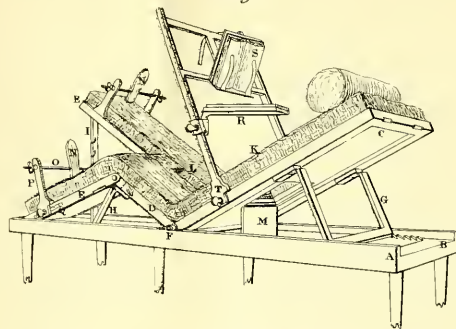


Fig. 8.



Fig. 9.



Fig. 10.



Fig. 3.

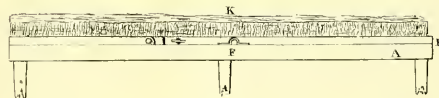


Fig. 5.

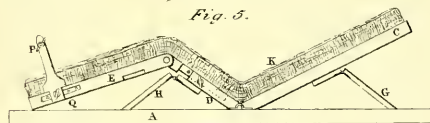


Fig. 4.

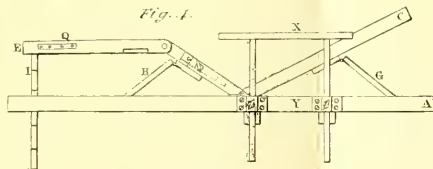


Fig. 6.

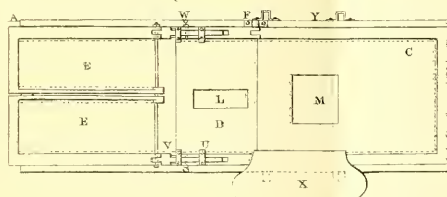


Fig. 7.

